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RECENT CHANGES IN THE NORTHERN EQUATORIAL BELT OF JUPITER.*

LATIMER J. WILSON.

The following tables present a complete report of the changes in this belt as observed by three members of the Planetary and Lunar Section of the Society for Practical Astronomy. The diagram represents chiefly the observations made in Nashville. The observations by Mr. J. J. Schafer and Mr. Hibbert Perceval Newton are fairly in accord with those made here and are shown only to October 1, to avoid confusion. Mr.

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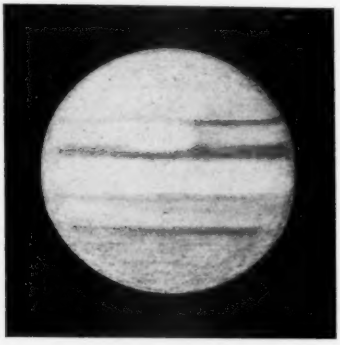

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DRAWINGS OF JUPITER BY HIBBERT PERCEVAL NEWTON.

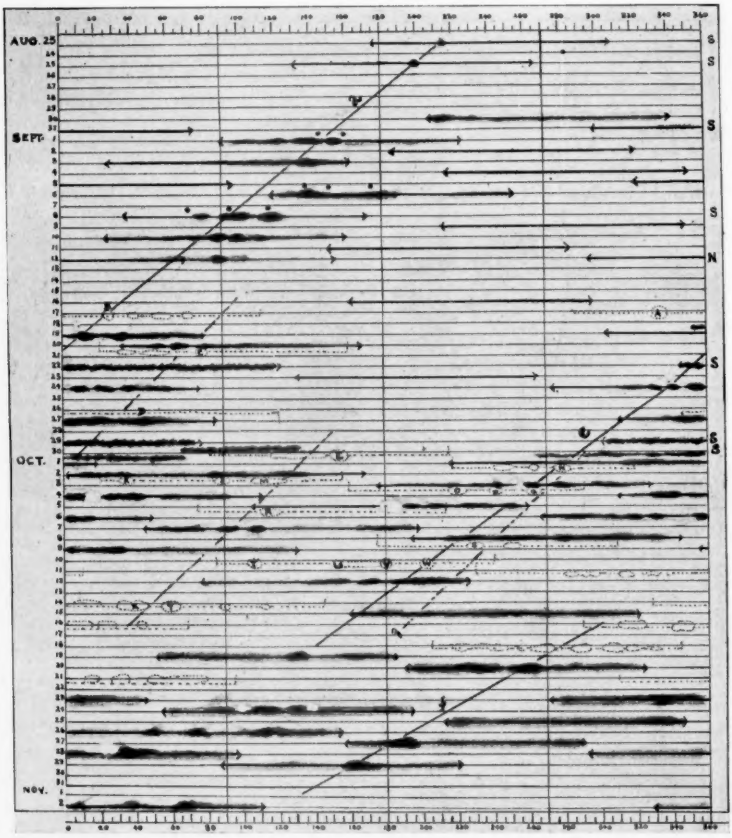
1912 May 11^d 21^h 53^m G.M.T. $\lambda_2=46°$
Image T=3: S=5. P. end S. Trop.
Disturbance. 3in. O.G.,x105.

1912 June 1^d 21^h 35^m G.M.T. $\lambda_2=313°$
Image T=m.5: S=6.
Red Spot Hollow. 3in. O.G.,x105&140.

Schafer's drawings were measured and the darkest spots in the belt are indicated by the black dots above the lines, while his observations are indicated in the margin by "S". Mr. Newton's drawing is shown on the diagram by "N" in the margin. For convenient comparison, Mr. Apple's observations as published in POPULAR ASTRONOMY No. 201 are also indicated on my diagram by the dotted lines. The principle spots on his plot

* The nomenclature is that adopted by the Jupiter Section of the B.A.A.

lettered "a", "b", etc., are "A", "B", etc., on my drawing. As can readily be seen, he is correct concerning the general drift of the groups of spots. It seems to me however that his third group is the preceding part of the first group, the forward spreading of the disturbance having apparently been more rapid than the drift of the spots. I have attempted to show this by the lines "a" and "e". I have also tried to identify the large dark spot shown on October 20, the line "f" indicating its motion. Seeing was not the best because of the low altitude, but these spots were certainly seen.



PLOT OF THE NORTHERN EQUATORIAL BELT OF JUPITER, AUGUST TO NOVEMBER, 1912. DISTURBED AREA IN LATITUDES 8°.5 TO 13°.0 NORTH AS OBTAINED FROM 40 DRAWINGS.

Observations by Latimer J. Wilson with 11-inch Reflector, 7-inch Reflector and 3⅜-inch Refractor. Magnification of 300± on the 11-inch and 200± on the 7-inch.

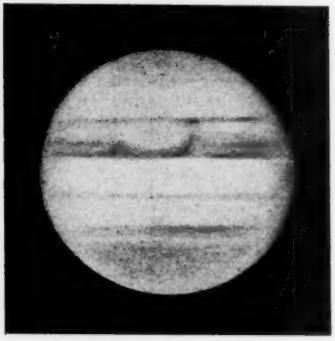
1912 August 30 to November 2.

[Transit of markings across the Central Meridian obtained from eye-estimates. Those not on Central Meridian were measured from drawings to find their longitudes.]

Date	G.M.T. h	m	Long. of principal markings in N. Eq. Belt.	A*	S*	Central Meridian °
Aug. 30	13	6	214°.	11	2	274
31	14	30		11	3	9
Sept. 1	13	24	120°, 140°, 153°.	11	2	160
2	14	37		11	3	354
3	13	15	140°.	7	3	95
4	14	19		11	3	284
5	13	6		7	4	29
6	13	18	Very dark at 140°. Dark from 187° to prec.limb.	11	3	187
9	13	25		11	4	282
10	14	0	75°, 90°, 100°, 112°.	11	4	93
11	13	15		11	4	217
12	13	10	90°	11	3	3
16	12	48		7	4	229
19	14	15	12°, 33°.	7	4	13
20	12	33	55°, 65°, 80°.	7	4	101
23	12	45		3⅜	3	198
24	12	24	330°, 338°, 350° to following limb.	11	3	335
24	12	29	338°.	11	3	338
24	12	37	343°.	11	3	343
24	12	40	338°, 347°, 357°.	11	3	345
24	13	19	9°, 20°, 35°, 320°, 345°.	11	4	9
27	12	3	Dark from 345°, 10°, 20°, 50° to 60°	11	4	19
Oct. 1	11	47	Dark from 308° to fol. limb.	3⅜	3	283
1	12	35	Dark from 328° to fol. limb.	7	5	312
2	11	40	Darkest from prec. limb to 40°. Whole belt dark.	3⅜	4	69
2	12	5	Dark at prec. limb and 84°.	3⅜	4	84
2	12	37	Dark at prec. limb, 90°, and 120°.	7	3	103
2	12	50	Dark from prec. limb to 140°.	7	4	110
3	12	20	260°, 275° to fol. limb.	7	4	243
3	12	52	247°, 262°, 275° to fol. limb	7	4	263
4	11	52	337°, 7°, 27° to fol. limb.	7	3	17
4	12	7	11° to prec. limb. 26°, 40° faintly to fol. limb.	7	3	26
4	12	37	17° to prec. limb. 38°, 55° faintly to fol. limb.	7	4	44
5	12	3	Very faint 203° to fol. limb.	7	3	173
5	12	23	197°, 220° to fol. limb rather dark.	7	3	185
5	12	35	190°, 202°, 217° to fol. limb	7	4	192
6	12	21	304°, 320°, 332 and 4°–entire belt dark.	7	2	334
6	12	31	332° to prec. limb and 358 to fol. limb.	7	3	343
7	12	1	95°, 110°, to prec. limb.	7	3	112
7	12	31	120° to prec. limb, 173° to fol. limb.	7	4	133
8	11	57	210° to fol. limb.	7	3	260
8	12	27	Entire belt dark, but darkest at 278°.	7	4	278
9	12	20	Darkest from 30° to prec. limb.	7	3	64
12	12	5	Belt darkest from 145° to fol. limb.	7	3	145
12	12	29	154°, 169°, 184° to fol. limb.	7	3	159
15	11	53	Whole belt dark from 188° to fol. limb.	7	4	228
15	12	35	Belt dark across disc.	7	4	253
19	12	12	" " " " Darkest spot 129°.	7	5	119
20	11	55	" " " " " " 224° and 254°.	7	4	259
23	11	40	Darkest spot at 340°.	7	4	340
24	11	26	" 107°–preceded by white spot.	7	3	122
24	11	35	" from 97° to 132° prec. and fol. by white	7	4	127
25	11	40	Belt darkest at prec. and fol. limbs.	7	5	280
26	11	38	Dark spots at 45° and 70°; belt darkest 109°.	7	3	69

* "A" = Aperture. "S" = Seeing, Scale of 5, 1 = best.

Date	G.M.T.		Longitude of principal markings in N. Eq. Belt	A	S	Central Meridian
	h	m				°
Oct. 26	11	52	77°, 107° to fol. limb.	7	4	77
26	12	8	Intensely dark at 104°. Dark at 72°.	7	4	87
27	11	45	Darkest at 198°; entire belt dark.	7	4	223
28	11	36	Intensely dark spot at 38°.	7	3	8
28	11	50	" " " 33°; belt apparently double.	7	3	16
28	12	10	Very dark area at 30°;extending into equat.zone.	7	4	28
29	11	31	Darkest from 155° to 170°.	7	4	155
Nov. 2	11	35	15°, 36°; darkest at 61°.	7	4	36
2	11	45	34°, 64°. Entire belt dark.	7	4	44



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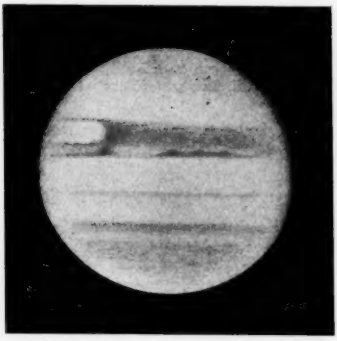

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DRAWINGS OF JUPITER BY HIBBERT PERCEVAL NEWTON.

1912 June $16^d\ 18^h\ 55^m$ G.M.T. $\lambda_2=312°.5$. Image T= h.6; S=4. Red Spot Hollow. 3in. O.G., x140.

1912 July $28^d\ 16^h\ 25^m$ G.M.T. $\lambda_2=53°.5$. Image T=t.S.6: S=4. S. Trop. Disturbance 3in. O.G., x105, 140.

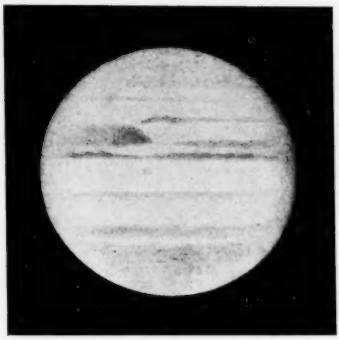
Observations by J. J. Schafer, Port Byron, Ill., with a 6-inch Refractor, Power of about 130.

1912 Aug. 12 to Nov. 2

Date	G.M.T.		Long. of principal markings in N. Eq. Belt	A	S*	Central Meridian
	h	m				°
Aug. 12	13	30		6		41
14	14	30		6		17
14	15	10		6		41
17	13	45		6		83
17	14	45		6		119
18	13	40		6		228
21	14	30		6		349
23	13	15	Spot approx. at 215°.	6		244
24	13	15		6		33
25	13	40	Dark spot at 199°.	6		199
25	14	19	Dark spot at 192°.	6		222
27	13	0		6		115
31	13	0	Slightly dark from 354° to 334°.	6		354
Sept. 1	13	10	Very dark spots at 161° and 146°.	6		161
5	13	5		6		29

* Seeing not indicated except on drawings of Oct. 19, 26 and Nov. 2. The last two are poor.

Date 1912	G.M.T. h	m	Longitude of principle markings in N. Eq. Belt	A	S	Central Meridian °
Sept. 6	13	0	Slightly dark at 134°; very dark 149°, 176°.	6		176
8	12	45	Very dark 72°, 97° and 117°.	6		107
19	13	45	Dark from 354° to fol. limb.	6		354
22	13	0	Entire belt dark.	6		57
29	12	57	Entire belt dark.	6		7
30	12	0	Dark from 141° to prec. limb.	6		141
Oct. 1	12	15	Dark from 264° to fol. limb.	6		294
1	13	40	Entire belt dark, but darkest spot at 352°.	6		352
3	11	50	Dark at 200°, 220°, and from 235° to fol. limb.	6		225
4	12	0	Dark from 17° to prec. limb,–25° to fol. limb.	6		21
5	11	45	Dark from 132° to prec. limb.	6		162
7	12	0	Dark from 114° to prec. limb.	6		109
12	11	40	Belt ragged and darker from 109° to prec. limb.	6		120
13	11	45	Belt dark across disc.	6		255
19	11	25	(Steady seeing) belt dark and ragged.	6		91
26	11	35	Darkest in 57°, 67°, 77° and 97° to fol. limb.	6		67
Nov. 2	11	0	Dark across disc,–darkest in 360°, 16°, 26°.	6		16



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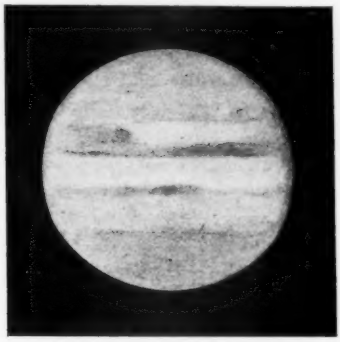

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DRAWINGS OF JUPITER BY HIBBERT PERCEVAL NEWTON.

1912 July $28^d\ 17^h\ 35^m$ G.M.T. $\lambda_2 = 96°$
Image T=S. 5: S=4 to 3. F. end S. Trop. Disturbance. 3in. O. G., x 140

1912 Sept. $12^d\ 15^h\ 30^m$ G.M.T. $\lambda_2 = 87°$
Image T=t. 7: S=7. N.E.B. Disturbance 3in. O. G., x 105.

Observations by Mr. Hibbert Perceval Newton, with a 3-inch Mogey Refractor

Date 1912	G.M.T. h	m	Long. of principal markings in N. Eq. Belt	A	S	Central Meridian °
Aug. 13	16	26		3	7	317
20	16	55		3	7	286
21	16	30		3	5	62
25	15	30		3	5	265
Sept. 9	16	0		3	7	15
11	14	55		3	7	275
12	15	30	Dark spot in long. 87°.	3	7	87

Intensity of the belt noted on Oct. 3, 316° = C. M. Oct. 6, 58° = C. M. Oct. 8, 332° = C. M. Oct. 11, 73° = C. M. Oct. 19, 182° = C. M., preceding part darker than following part. Oct. 27, 73° = C. M. Scale of seeing 1 = best, 10 = limit.

THE DEBT WHICH ASTRONOMY OWES TO ORMSBY MACKNIGHT MITCHEL.*

EVERETT YOWELL, Ph.D.

In the early forties, the Queen City was the most thriving town west of the Alleghenies; she boasted of her river commerce, of her population of some 50,000, of her institutions of learning. Among them was the Cincinnati College, in whose faculty was Ormsby MacKnight Mitchel, professor of engineering, mathematics, and mechanics. A graduate of West Point, he found the routine duties of garrison life too tame for his active spirit, resigned from the army and returned to his native state. Naturally he drifted into teaching and engineering, for which his training in the best engineering school of that period had specially fitted him. As engineer, he was connected with the first railroads entering the city; as teacher, with the Cincinnati College where he mastered the art of presenting his subjects in an attractive form to his students. Astronomy was among the subjects he taught, and his interest in the subject grew steadily. He was hampered by the lack of instruments to illustrate his lectures; he saw the need of an observatory, adequately equipped, and felt acutely the reproach of European scientists that Americans were wholly devoted to the pursuit of the almighty dollar. He also saw that in this country the people must support and cherish science even as the crowned heads did abroad.

If we glance at the state of astronomy in America at that time, we notice encouraging signs, in spite of Airy's statement to the British Association in the preceding decade that no observatory existed in the United States. Bowditch had won international fame by the publication of his "Practical Navigator" and the translation of and commentary on LaPlace's "Mechanique Celeste." Yale had mounted a small glass (1830), used chiefly for instruction, although observations were made on Halley's Comet in '35 before news of its observation in Europe had been received. Williams College dedicated a small observatory (1836), used as an adjunct in teaching natural philosophy. Professor Loomis had mounted a small glass (1838) for the Western Reserve College at Hudson, Ohio, and the newly organized Philadelphia High School had purchased and mounted (1840) an equatorial of six inches aperture and a meridian circle of 4½ inches, the finest equipment then in this country. With it Sears C. Walker did excellent work. Wm. Bond had a private

* Address at the opening of the O. M. Mitchel Building of the Cincinnati Observatory.

observatory in Dorchester, Mass., which was transferred to Cambridge in 1839 and became the nucleus of Harvard College Observatory. All of these, except Bond's were connected with schools and their work depended on the zeal of the professor in charge and the amount of time he could spare from his other duties.

The Cincinnati Society for the diffusion of Useful Knowledge requested Mitchel to lecture before it in the winter of 1841-42. He selected "The Stability of the Solar System" as his theme. It was received with so much interest, that a series of lectures on Astronomy were given at the conclusion of the regular course. The last lecture was repeated, by request, in Wesley Chapel and at its close Professor Mitchel explained his plan for establishing an observatory: to obtain at least 300 subscriptions of $25 each, the subscribers to have the right to visit the observatory and use the instruments under the guidance of the director. In two respects the proposition was notable—first, in seeking by popular subscription to obtain the necessary funds; second, in giving the members of the Society the right to use the instruments. The opening of this building bearing Mitchel's name, housing Mitchel's telescope, dedicated to the use of the general public bears witness that we have held inviolate the rights of the old Astronomical Society, now represented by all our citizens, for the Observatory now belongs to the city. This plan of equipping an up to date observatory seemed the height of Quixotism to many, but Mitchel was not daunted by the prospect of difficulties. By a personal canvass, he obtained in three weeks the required number of subscribers and organized the Cincinnati Astronomical Society on May 23, 1842. He continued to be the center of the Society and the statement of the obstacles he surmounted in reaching his goal reads like a romance. Sent to Europe to purchase the telescope, to study plans for his observatory and to prepare himself for the duties of astronomer, he visited the great national establishments at Greenwich and Paris as well as many smaller ones. At last he found in Munich the glass desired, a 12-inch objective that would cost $9500, the finest glass in the world outside of the Russian Imperial Observatory at Pulkova. Although the price seemed prohibitive, he made a provisional contract and then returned home to consult the Society; his enthusiasm and vigor carried the Society with him, and the additional funds were raised and the telescope bought.

The second part of the plan, the erection of the building to house the telescope, now engaged Mitchel's attention. Judge Longworth had donated the lot on the brow of Mt. Adams on condition that the building should be completed by a certain date. A new set of difficulties confronted Mitchel, as he was forced to begin the erection of the building without a cent in his treasury. He built a road to Mt. Adams to

rtansport his material, quarried his own stone, dug his own sand, burned his own lime, even temporarily dammed a gully during a rain to collect the necessary water for mixing his mortar. Each morning he visited his works, giving necessary directions to the foreman before beginning his teaching at 8 o'clock; each afternoon he solicited subscriptions of stock, accepting in lieu of money, material, labor or merchandise of any kind; they tell of his accepting a load of produce from a farmer and selling it himself to obtain the hard cash. The week's end found his resources exhausted, but his accounts square, and he began the new week with renewed hope and unabated zeal. He persuaded John Quincy Adams, though in his seventy-seventh year, to make the long journey from his home in Massachusetts to lay the corner stone .During his term in the White House Mr. Adams had in vain called the attention of Congress to the necessity of erecting a national observatory. How deeply he was interested in astronomy may be judged from his answer to Mitchel: "Sir, if I were to follow the impulse of my present feelings, I would unhesitatingly answer 'yes, I will go at the risk of my life,' for God knows that if I could be spared to participate in so interesting a ceremony, one that I feared I should never witness, I would be willing to die the next day. My hopes would be more than realized, and the toil of twenty years fully repaid." The journals of the day narrate how all Cincinnati turned out on the 9th of November 1843, in spite of the driving rain, to do honor to the venerable ex-president, and the hill on which the Observatory was placed still bears his name.

Having completed the building and mounted his telescope, Mitchel was ready to begin his first astronomical work, the measurement of the double stars in our southern sky. But new troubles arose when fortune seemed most propitious; the College burned down, depriving Mitchel of his only means of support. He had given the Society his promise to support the observatory for ten years without expense to the society. Certainly, he could not desert his observatory—that never occurred to him; equally certain was it that he must find a new way to support his wife and children. His lectures here had been so successful that he decided to try lecturing in the East. Boston was selected for his first attempt, as he believed he would surely fail elsewhere should he not succeed there. A scant hundred attended his first lecture; they fell captive to the charm of his oratory, the grace of delivery and the clear treatment of his profound subject. The audiences steadily increased until the hall was crowded; the course proved a remarkable success and Mitchel entered into a new field of usefulness as a popular lecturer. With a native gift for oratory, vivid imagination and whole hearted devotion to his favorite science, he aroused the intensest interest and enthusiasm and his audiences ranged from the hundreds into the thousands. This

phase of his career exerted a powerful influence on American astronomy. Hampered in his research work by the lack of technical astronomical training, limited in opportunity by the necessity of devoting much time to the members of the society who had a right to visit the observatory frequently, compelled to earn his living by other labors, he was unable to accomplish as much research work with the magnificent glass as was expected. In the spread of astronomical knowledge, in drawing the attention of thinking people to the beauties of astronomy, and inspiring them with enthusiasm he paved the way for the founding of other observatories, the endowment of other institutions, and attracted to the subject young men of ability whose later work was creditable to American astronomy. The spirit of emulation and competition is as valuable in science as in other subjects, and when other communities realized what had been accomplished by our citizens in providing an observatory for scientific work and popular instruction, it was a powerful incentive to action; thus we witness the establishment and equipment of many observatories in the succeeding years. Mitchel himself delivered the oration at the dedication of Hamilton College Observatory in 1856; he was called upon, at the close of a series of five popular lectures in New York City in 1859, to deliver an extra one following which plans were made to establish an observatory in Central Park—a project abandoned when the Civil War turned all activities in another direction.

We recognize today as Mitchel did, that the advancement of science depends not only on the original research of investigators, but also on the wide diffusion of their results among other scientists, students and thinking men; that a large clientele of serious minded appreciative men is needed to support the activities of the comparatively few men engaged in research; that the most valuable results may be expected from those freed from the need of spreading their energies over other fields. When we read of some 2000 people listening to Mitchel in our own city, of the halls of the East being packed with the best representatives of those communities, we cannot doubt that Mitchel did more than any other man to arouse that general interest in astronomy that resulted in giving us the best equipment and some of the foremost astronomers of the world.

In July 1846, Mitchel began the publication of the Sidereal Messenger, a journal designed for popular use, the first of its kind to be issued. It failed in its purpose of assisting in the support of the observatory and after two years of struggle expired in October '48 leaving a brief but glorious record. It was too far ahead of its time, but undoubtedly did something in preparing the way for the appearance of the Astronomical Journal in the following year—a journal devoted to

the technical side of astronomy, which still has a precarious existence.

Mitchel published his first popular work, "Planetary and Stellar World", in 1848. It consisted of ten lectures similar to those he delivered, though he never wrote the lectures he delivered. Its success led him to publish his "Popular Astronomy" which was also well received; our observatory copy is one of the seventh edition. After his death appeared "The Astronomy of the Bible," a series of popular lectures.

In connection with the longitude work by the Coast Survey in 1848, the problem of automatically breaking the electric circuit was proposed to Mitchel and solved by him. Bond had already solved it in a different manner. The following summer Mitchel invented his revolving disc for recording observations, thus perfecting a chronograph. The spring governor cylindrical chronograph which Bond submitted to the Coast Survey in the following year was so much better than Mitchel's that it came into general use, and soon the new American way of observing spread abroad and replaced the eye and ear method.

Mitchel was called to Albany in 1859 as Director of the Dudley Observatory and left Cincinnati the following spring. Before he had accomplished much of importance there the war broke out and Mitchel re-entered the army as brigadier general of volunteers. His service was short but brilliant and he fell a victim to yellow fever in the fall of '62.

We may sum up his influence on astronomy in the words of Dr. Holden, the first director of Lick Observatory: "His direct service to practical observing astronomy is small, but his lectures, the conduct of the Cincinnati Observatory, and his publication of the Sidereal Messenger, together with his popular books, excited an intense and widespread public interest in the science and indirectly led to the foundation of many observatories. He was early concerned in the matter of utilizing the electric current for longitude determinations, and his apparatus was only displaced because of the superior excellence of the chronograph devised by the Bonds. His work was done under immense disadvantages, in a new community, but the endowment of astronomical research in America owes a large debt to his energy and efforts".

ASTRONOMY IN THE HIGH SCHOOL, VI.*
First use of Opera-Glasses

MARY E. BYRD.

Beginners in astronomy can hardly have a better instrument than their own eyes, opera-glasses have only a minor part in their work. But whatever time is assigned them should be carefully utilized to the best advantage, little things by no means being neglected. There is

*Other papers in this series have appeared as follows:—P.A. **11**, 550 (I), P.A. **12**, 24 (II), P.A. **12**, 199 (III), P.A. **13**, 545 (IV), P.A. **15**, 227 (V).

even need of practice to hold the hands steady and to look with steady eyes. "I can see better without the glasses" is, at first, a common remark.

The instrumental tests required are few and simple. A good pair of opera-glasses when pointed at the sky gives only one circle of light, and when the moon is observed shows no wings nor extraneous light of any kind, though a little does no harm, nor is the appearance of two circles a serious defect. In the high-power glasses, like those of Zeiss, it is corrected by adjusting the space between the barrels to fit individual eyes. Two images of a single object are an entirely different matter, and render the glass worthless.

At least one instrumental measure is important, that is, to find the diameter of the object glasses. Nothing, however, should be laid on the glass itself, but instead, let a finely graduated scale be placed centrally across the rim of the cell, then align downward, and take readings at the extremity of a diameter.

The two more critical tests remain, to find extent of field and magnifying power. By field of view is meant the section of the heavens that is visible at one and the same instant. If a rigorous determination is not demanded, it is readily obtained by referring to the stars, preferably those near the equator. Thus, for a particular pair of glasses, it is found that the star-line γ Ceti α Piscium can be brought to coincide almost exactly with a diameter of the field, falling short of its length by $\frac{1}{4}$ of $\gamma\,\delta$ Ceti. The corresponding numerical value derived from Proctor's Atlas is 11°, and that combined with two other estimates gives 10°, as the approximate diameter sought.

To find the magnifying power of opera-glasses, there must be a comparison between an object seen directly and its magnified image. Small panes of window glass, or bricks in a building are often employed, and the following method, which can be varied in details according to convenience, has some advantages.

On a sheet of white card-board, paste three or four rectangular pieces of paper, let them be several inches in diameter, and of the same size, but contrasting in color, with the one on the right cut from plotting paper. Having placed the card-board securely in a vertical position, look at it through the glasses, and focus them carefully, using both eyes. Then look at the rectangles, directly with one eye, and with the other through the glasses. Bring the left-hand side of a magnified image to lie exactly on the same side of the left-hand rectangle itself and, keeping that position, note just where the right-hand side of the image falls. If, for instance, there are three rectangles and the diameter of the image extends across two of them and a fourth of the way over the third, the power of the glasses is said to be two and a fourth. To decide whether the correct value is a little more or a little less, draw heavy black lines

the technical side of astronomy, which still has a precarious existence.

Mitchel published his first popular work, "Planetary and Stellar World", in 1848. It consisted of ten lectures similar to those he delivered, though he never wrote the lectures he delivered. Its success led him to publish his "Popular Astronomy" which was also well received; our observatory copy is one of the seventh edition. After his death appeared "The Astronomy of the Bible," a series of popular lectures.

In connection with the longitude work by the Coast Survey in 1848, the problem of automatically breaking the electric circuit was proposed to Mitchel and solved by him. Bond had already solved it in a different manner. The following summer Mitchel invented his revolving disc for recording observations, thus perfecting a chronograph. The spring governor cylindrical chronograph which Bond submitted to the Coast Survey in the following year was so much better than Mitchel's that it came into general use, and soon the new American way of observing spread abroad and replaced the eye and ear method.

Mitchel was called to Albany in 1859 as Director of the Dudley Observatory and left Cincinnati the following spring. Before he had accomplished much of importance there the war broke out and Mitchel re-entered the army as brigadier general of volunteers. His service was short but brilliant and he fell a victim to yellow fever in the fall of '62.

We may sum up his influence on astronomy in the words of Dr. Holden, the first director of Lick Observatory: "His direct service to practical observing astronomy is small, but his lectures, the conduct of the Cincinnati Observatory, and his publication of the Sidereal Messenger, together with his popular books, excited an intense and widespread public interest in the science and indirectly led to the foundation of many observatories. He was early concerned in the matter of utilizing the electric current for longitude determinations, and his apparatus was only displaced because of the superior excellence of the chronograph devised by the Bonds. His work was done under immense disadvantages, in a new community, but the endowment of astronomical research in America owes a large debt to his energy and efforts".

ASTRONOMY IN THE HIGH SCHOOL, VI.*
First use of Opera-Glasses

MARY E. BYRD.

Beginners in astronomy can hardly have a better instrument than their own eyes, opera-glasses have only a minor part in their work. But whatever time is assigned them should be carefully utilized to the best advantage, little things by no means being neglected. There is

*Other papers in this series have appeared as follows:—P.A. **11**, 550 (I), P.A. **12**, 24 (II), P.A. **12**, 199 (III), P.A. **13**, 545 (IV), P.A. **15**, 227 (V).

even need of practice to hold the hands steady and to look with steady eyes. "I can see better without the glasses" is, at first, a common remark.

The instrumental tests required are few and simple. A good pair of opera-glasses when pointed at the sky gives only one circle of light, and when the moon is observed shows no wings nor extraneous light of any kind, though a little does no harm, nor is the appearance of two circles a serious defect. In the high-power glasses, like those of Zeiss, it is corrected by adjusting the space between the barrels to fit individual eyes. Two images of a single object are an entirely different matter, and render the glass worthless.

At least one instrumental measure is important, that is, to find the diameter of the object glasses. Nothing, however, should be laid on the glass itself, but instead, let a finely graduated scale be placed centrally across the rim of the cell, then align downward, and take readings at the extremity of a diameter.

The two more critical tests remain, to find extent of field and magnifying power. By field of view is meant the section of the heavens that is visible at one and the same instant. If a rigorous determination is not demanded, it is readily obtained by referring to the stars, preferably those near the equator. Thus, for a particular pair of glasses, it is found that the star-line γ Ceti α Piscium can be brought to coincide almost exactly with a diameter of the field, falling short of its length by $\frac{1}{4}$ of $\gamma\,\delta$ Ceti. The corresponding numerical value derived from Proctor's Atlas is 11°, and that combined with two other estimates gives 10°, as the approximate diameter sought.

To find the magnifying power of opera-glasses, there must be a comparison between an object seen directly and its magnified image. Small panes of window glass, or bricks in a building are often employed, and the following method, which can be varied in details according to convenience, has some advantages.

On a sheet of white card-board, paste three or four rectangular pieces of paper, let them be several inches in diameter, and of the same size, but contrasting in color, with the one on the right cut from plotting paper. Having placed the card-board securely in a vertical position, look at it through the glasses, and focus them carefully, using both eyes. Then look at the rectangles, directly with one eye, and with the other through the glasses. Bring the left-hand side of a magnified image to lie exactly on the same side of the left-hand rectangle itself and, keeping that position, note just where the right-hand side of the image falls. If, for instance, there are three rectangles and the diameter of the image extends across two of them and a fourth of the way over the third, the power of the glasses is said to be two and a fourth. To decide whether the correct value is a little more or a little less, draw heavy black lines

lengthwise on the plotting paper, so that they mark out two small rectangles on the left, with diameters respectively a fourth and a third of the original one and, after that is done, repeat the test.

Since placing and holding the magnified image is hardly as easy as it sounds, it is often desirable to spend the first period in preliminary trials, making definite estimates later. The observer should always stand or sit as far as is convenient from any object used in testing, so that the focus may not differ largely from that employed for celestial objects. The mean of five or six measures, made on two different days, should give a satisfactory result. Note that diameters, not areas, are to be employed.

Focusing requires special attention. To begin with, it is well to look in the daytime at some distant terrestrial object, alternately lengthening and shortening the barrels, until the sharpest image is reached from opposite directions; and then bring that position back quickly. In like manner the moon, if possible, should be examined in the evening. Some such procedure as this is desirable, for the eye, unlike the hand, has little initiative. So slight is its control of external things, that it has a tendency to accept passively what is given, striving, as it were, to do its best under limitations, whereas it ought to work under ideal conditions as nearly as possible.

Whatever observation is undertaken with opera-glasses, it is, therefore, essential to obtain the best possible focus before anything else is attempted. Early in observing also it is only fair to caution beginners not to expect too much; the sun and planets, although so bright, are apt to prove disappointing. With regard to the latter, actual trial should be made to see how the instrument used affects color and brightness, and whether it shows a disk for Jupiter or Venus or any satellite for Jupiter.

For the sun, make first an examination with dark spectacles only, and then find how the opera-glass affects its size, color and brightness. Note also whether the limb is clear-cut or ill-defined, whether any one part is brighter than another, and if the body looks like a flat disk laid on the sky, or more like a sphere. For the moon, there may be a somewhat longer list of points, including those suggested for the sun, as well as the following:

1. Find whether the glasses show a direct or inverted image.
2. Note whether they appear to affect the moon's diurnal motion.
3. Compare the views of the terminator, seen with and without the glasses.
4. Examine different phases in the same lunation.
5. Examine the same phase in different lunations to ascertain whether the markings change their position with regard to limb or terminator.

6. With the help of a lunar map, identify a few of the so-called seas.

Doubtless the most interesting bodies to observe with an opera-glass are double stars and star clusters. There is something thoroughly pleasing to the eye, when two stars flash out where before only one was plainly seen, and when a hazy patch of light like Coma Berenicis, is resolved into a large number of separate stars.

If two periods in different seasons are available, let the working-list include the following objects:

1. Hyades, Pleiades and Coma Berenicis.
2. Nebulae of Andromeda and Orion.
3. ζ Ursae Majoris, α Capricorni and ε Lyrae.

Whatever object is examined, the aim should be to find answers to definite questions. Different individuals of the same class should be compared, and points of similarity and contrast noted. As an illustration, let it be assumed that α Capricorni is to be observed, with ζ Ursae Majoris taken as a standard. First let the latter be carefully scrutinized, so as to fix in mind a mental picture of the two stars Alcor and Mizar, their color, relative brightness, and distance apart. Turn then to α Capricorni and answer questions like these:

1. Are the components of α Capricorni equal or unequal in brightness, i. e., in stellar magnitude?
2. How do these stars compare in brightness with those of the ζ pair?
3. What color or colors are assigned to the components of α?
4. How do the α stars compare in color with Alcor and Mizar?
5. What is the distance separating the α stars in terms of that between the components of ζ Ursae Majoris?

Before notes are written out, it is well to go over the points included more than once, and look back and forth at α and ζ several times.

Note-writing in astronomy, both in preliminary exercises and in observations, demands much careful attention. Just what to include and what to exclude is often puzzling for those with experience. It is probably safe to err on the side of entering too many rather than too few details, and even then it is often a surprise to find, on referring later to the note-book how much is remembered more or less distinctly that was not recorded. But it is one of the fundamental rules to make no use in conclusions and deductions of anything not set down in the notes. It is true here, as in describing scenery that, "half a word fixed on or near the spot is worth a whole cart load of recollection afterward."

Among essentials, should be included place, date, and time of observing, and for the moon, its age. With any instrument employed, note should be made of two or three of its main properties, as for example with the opera-glass, the diameter of its objectives, and its magnifying

power. The two principal rules are, record all observations in pencil, and make and record all observations independently, that is, be as free as possible from any bias as to what others, even astronomers, see and write. Students of literature are permitted to criticise Shakespeare as a poor writer and beginners in astronomy should have as large a liberty,

Work of the character here described may seem rather prosaic! especially after reading the accounts of enthusiasts who set forth in glowing language the beauties revealed by their glasses. All would grant that beauty everywhere should receive its meed of appreciation, but when opera-glasses are used in the study of astronomy, the main object is not to see something pretty but to find out something.

THE DEVELOPMENT OF COSMOLOGICAL IDEAS.

HECTOR MACPHERSON Jr., M. A., F. R. A. S.

Perhaps the greatest service which astronomy has rendered to the human mind consists in the fact that it has shown the true position of the earth in the Universe. Thanks to astronomy and physics we have now cosmological ideas which although necessarily incomplete are in the main a representation of reality.

It is an interesting task to trace the development of ideas concerning the earth and its place in the scheme of things. In this development there are certain well-defined periods. (1) The purely speculative period of ancient thought; (2) A period from the rise of the mathematical school of astronomers who developed the Ptolemaic system to the fall of the scholastic philosophy; (3) The period opened by the revolutionary work of Copernicus, which enormously extended our knowledge of the extent of space; (4) The period opened by the discoveries of Herschel, a period distinguished by a further extension of the Universe in space and also in time. In this period we have reached the fully developed evolutionary conception of the Universe.

There is a peculiar charm in connection with the study of the first period, just because its beginnings are lost in the mists of antiquity. To this period belong the Babylonian, Hebrew, Egyptian and Greek ideas of the world and its origin. To the first named people the earth was a great mountain, hollow underneath, above which the sun, moon and host of heaven, the divine ones, moved in their paths. The heaven was a solid vault, supported by the deep on which the earth rested. There are resemblances between the Babylonian cosmology and that of

the Old Testament, the difference being that the fantastic atrological and idolatrous notions of the Babylonians were purged away from the Hebrew conception of the world. Thanks to the unifying power of the monotheistic ideas the Hebrew writers, however crude their cosmology, were fully aware of the unity of the Universe and the subordination of all the forces and powers in the universe to the all-commanding might of Yahwe. As Schiaparelli has very truly pointed out, the Hebrew mission to the world was the purification of monotheism; and in accomplishing this the writers of the the Old Testament naturally emphasized the unity of nature. This is noticeable not only in the references to the external Universe, but also in the first account of the Creation (Genesis I) which, whether derived from Babylon or not, was developed in accordance with the Hebrew view of the Universe as the creation of God.

The Hebrew cosmogony was a marvelous intuition; the Hebrew cosmology was crude enough. As Schiaparelli remarks, the Jews held to "the cosmography of appearances." The earth was flat, and there were waters above the firmament and below the firmament. "The heaven with the air on the one side, the abysses, with Sheol and the lowest points of the earth on the other, would come to form two equal halves, separated by the plane containing the surface of the earth and seas and symmetrically placed in relation to that plane. Such a cosmic system or body might then perhaps have a spherical shape." Thus the Hebrew conception of the Cosmos was no less primitive than that of the other ancient peoples, but, thanks to the unifying force of the monotheistic ideal, it was less fantastic and arbitrary.

The Greeks had a much more speculative bent than the other ancient peoples. But their cosmology, as reflected in the pages of Homer and Hesiod, is in every way as childlike as that of the Babylonians, Egyptians and Chaldeans. The flat earth is surrounded by the mighty river Oceanos, out of which the heavenly bodies rise in the morning and into which they fall at night. Almost as crude were the ideas of Thales, the first great philosopher of Greece. In the ocean of water, the principle of which everything is formed, the earth, a circular disc, is floating like a piece of wood. Anaximander, who held that the first principle is the nature of the infinite or the limitless, believed the earth to be flat and in equilibrium in the center of the world. The sun was a hole in a great ring through which the inhabitants of the earth got a view of the fire which filled the rim of the ring, while moon and stars were similarly explained. Anaximenes inclined to the view of a solid vault, to which the stars were attached like nails while sun, moon and stars were flat bodies supported by the density of the air. Xenophanes regarded sun, the moon and stars as fiery clouds formed by atmospheric exhalations.

The first real forward step in cosmology was taken when Parmenides perceived the spherical form of the earth, a doctrine accepted by the Pythagorean school and by Plato and Aristotle but rejected by Heracletus. Pythagoras put forward the order of the revolution of the planets round a central fire, not the sun; while Hicetas taught the rotation of the earth and Aristarchus the earth's revolution round the sun. These fruitful ideas were obscured by the new conception of the homocentric spheres of Eudoxus, a theory which Aristotle adopted. He likewise taught the spherical shape of the earth, which was the center of the Universe, fixed and immovable.

With the rise of practical astronomy under Hipparchus, the theory of the homocentric spheres of Eudoxus was seen to be quite useless. Dr. Dreyer remarks that Aristarchus, who put forward the idea of the motion of the earth round the sun, "was the last prominent philosopher or astronomer of the Greek world who seriously attempted to find the physically true system of the world. After him we find various ingenious mathematical theories which represented more or less closely the observed movements of the planets, but whose authors by degrees came to look on these combinations of circular motion as a mere means of computing the position of each planet at any moment without insisting on the actual physical truth of the system."

The theory which held sway for thirteen hundred years or so was that of Hipparchus and Ptolemy which regarded the sun, moon, planets and stars as in motion round the earth in cyclic and epicyclic paths. This theory formed the basis of the cosmology of mediaeval times.

It is not within the sphere of this sketch to inquire into the causes of the arrest of the human intellect after the conversion of the old to Christianity. It is sufficient to say that Greek culture had exhausted itself and the mind of man would probably have found rest in some form of scholasticism, whether Christian or not. The exhausted culture of the old world disappeared before the Barbarian invasions.

The early Christians held the views of the earth and its place in nature common to the pagan world. Many of the earlier apologists, so far from showing hostility to science, were at pains to show how science confirmed Christianity; but with the rise of dogmatic theology and scholastic philosophy, the churchmen of the day began to claim that the Bible taught not only religion but science. Hence certain passages in scripture, including the creation record in Genesis, were taken literally and out of their proper context, as literal scientific truth. The philosophy of Aristotle was enveloped in a kind of sacred halo and his views on the immobility of the earth were specially cherished, while as a third factor the Ptolemaic theory was no longer believed to be a convenient working hypothesis, but the true system of the world. It did

not occur to the Scholastics that Aristotle adopted the spherical theory of Eudoxus, overturned by Ptolemy, and that both Aristotle and Ptolemy knew little and cared less about the Hebrew cosmogony. Some of the early theologians indeed heaped ridicule on the Aristotelian theory of the spherical earth, but these were the exceptions; and the church held to the round earth, fixed and immovable, the end and aim of creation itself. As the years rolled on, and Aristotle became more and more sacred it was considered more and more heinous to question his authority. The Bible and Aristotle must not be doubted. The Christian earth depended on the truth of the geocentric theory. The heliocentric theory, one theologian declared, "upsets the whole basis of theology;" "It casts suspicion on the doctrine of the incarnation."

It may well be imagined that to a theological mind steeped in clerical bigotry and a philosophical and scientific mind steeped in Scholasticism, the appearance of the great work of Copernicus came like a bolt from the blue. Men had laid such unnecessary stress on the geocentric system of the world that they were quite in earnest about their opposition to Copernicus. Long and bitter was the struggle. Protestants vied with Roman Catholics in the bitterness of their attacks. "This fool," said Luther, "wishes to reverse the entire system of astronomy." "Who," said Calvin, "will venture to place the authority of Copernicus above that of the Holy Spirit?" In the long and bitter warfare which followed the Church of Rome took the leading part—as the burning of Bruno and the persecution of Galileo testify. It was impossible however to refute the new astronomy. The observations of Tycho led to the deductions of Kepler and Newton, which revealed to mankind the physicai necessity of the new system of the world.

It is difficult for us to-day to realize the magnitude of the scientific revolution which Copernicus initiated and which Newton completed. For hundreds of years men had considered the earth to be the center of the Universe, the end and aim of Creation. Man was the culmina- of the works of God, and the earth alone was inhabited. The sun was made to give light and heat to the earth, and the moon and stars were intended to be convenient secondary light-givers in the absence of the sun. Men had grown so accustomed to this theory that they had forgotten that it was merely a theory. Then with the acceptance of the Copernican system all was changed. The earth was brought down from its proud position as ruler and centre of the Universe to the humble place of a small planet revolving round the sun; so far from being the end and aim of Creation it was seen to be merely one body among others and by no means the largest. Kepler showed the solar system to be ruled by certain fixed laws, which were proved by Newton to be

but the expression of one great underlying principle of nature—the law of gravitation.

Gradually men's minds became adjusted to the new system of the world. Men of science accepted it. Philosophers and theologians began to see that the new system after all did not seriously affect their respective beliefs. Indeed the heliocentric system was specially acceptable to certain minds. The solar system, a great machine, ruled by an eternal inviolable law, was a conception which harmonized remarkably with the Deistic and semi-Deistic ideas prevalent in the religious world in the eighteenth century. Most of the expounders of the new astronomy were—like Newton,—what may for want of a better term be called Christian Deists—men who held that the Solar System had been created in substantially its present form and set in motion by the Creator who endowed it with its fixed law. The extension of the Universe in space effected by the Copernican system was by no means completed. The astronomers who succeeded Newton devoted themselves to the study of the Solar System. The stars beyond were studied more as convenient reference points for the investigation of the planetary motions than with a view to knowledge of their constitutions and mutual relations. When Herschel came on the scene he had a field to himself. The result of his investigations was a still further extension of the Universe in space. He discovered the binary stars thus showing that the law of gravitation held sway among the stars. He sounded the depths of space, revealing stars situated at distances so great that their light, he concluded, required thousands of years to reach the earth. He showed that the sun was in ceaseless motion through space, carrying with it the earth and the planets. He laid the foundations of the study of the Milky Way and stellar clustering.

Kant and Laplace had worked out, on paper, the nebular hypothesis of the origin of the Solar System. Herschel independently developed the theory. He pointed to nebulous objects in the sky in all stages of evolution and showed very clearly the method of Creation.

This was the beginning of the vast extension of the Universe in time with which we are familiar, and consequently the nebular theory was bitterly opposed.

The school of Deistic thinkers who held to the mechanical conception of the Solar System were extremely hostile. Sir David Brewster referred to the theory as "a dull and dangerous heresy," and even astronomers as a whole were pleased when the alleged resolution of the nebulae into stars seemed to refute Herschel. Then in 1864, not long after Darwin had applied the idea of evolution to the organic world, the spectroscope revealed the fact that the nebulae were what Herschel considered them to be—masses of glowing gas.

Since the invention of the spectroscope, the idea of celestial evolution has been placed on a very firm footing. Spectrum analysis demonstrated two facts. (1) It showed the unity of the Universe in a remarkable way. The same elements are found in the sun as on earth, and also in the distant stars. (2) It showed the stars to be at different stages of evolution. The inference is obvious. The Universe is not a machine, but a slowly evolving organism.

What is the cosmological conception of today and what is its bearing on men's thoughts of life and of destiny?

The idea of the Cosmos entertained by the modern scientist is vastly different from that of his predecessors in Greece and Babylon. As a distinguished writer has well said, "Compared with the fields from which our stars fling us their light, the Cosmos of the ancient world was but as a cabinet of brilliants or rather a little jeweled cup found in the ocean or the wilderness. Wonderful as were the achievements and sagacious as were the guesses of the Greek astronomers they little suspected what they were registering when they drew up their catalogues of stars."

To the thinkers of to-day the earth is no longer the center of the Universe. It is a planet revolving round the sun, from which it is distant ninety-three millions of miles. The sun itself is not the centre of the Universe. It is merely a star moving endlessly through space in a vast orbit and carrying with it its retinue of planets and comets. It is merely one star out of millions and by no means the largest star. The spaces which modern astronomy reveals are unthinkable. The sun is twenty-five millions of millions of miles from the nearest star. In this vast universe there is every possibility that there exist worlds on which there are other humanities and other civilizations—if not now, then in the past or future. For the astronomer of today realizes that the Cosmos so far from having been created six thousand years ago has been from an eternity and will be for ages to come. The universe is a great developing organism, and its component parts are in all stages of development and decay.

What is the Universe? The physicist has his answer. He shows us that the complexity of the Cosmos, of matter and motion, light and heat, and the imponderable ether, is apparent not real. He reduces all things to different forms of energy, working throughout an infinite and eternal Universe—an energy akin to that personified force of which Goethe writes—

"In Beings floods, in Actions storms
I walk and work, above beneath
Work and weave in endless motion

Birth and death
An Infinite Ocean
A seizing and giving
The fire of living
'Tis thus at the roaring loom of time I ply
And weave for God the Garment thou see'st Him by."

This conception of the Cosmos as the living garment of God is coming more and more to the front and is displacing more and more the old conceptions of the mechanism of the Universe. It is a grander idea, for it contains within itself the finer elements in the older theory. Flammarion gives expression to the magnificent modern view of the Cosmos in his words—"Our science is but a shadow on the face of the reality. Infinity encompasses us on all sides, life asserts itself, universal and eternal, our existence is but a fleeting moment, the vibration of an atom in a ray of the sun, and our planet is but an island floating in the celestial archipelago, to which no thought will ever place any bounds. Never lose sight of the fact that space is infinite, that there is in the void neither height, nor depth, nor right nor left; and in time neither beginning nor end. We must understand that our conceptions are relative to our imperfect and transitory impressions and that the only Reality is the Absolute."

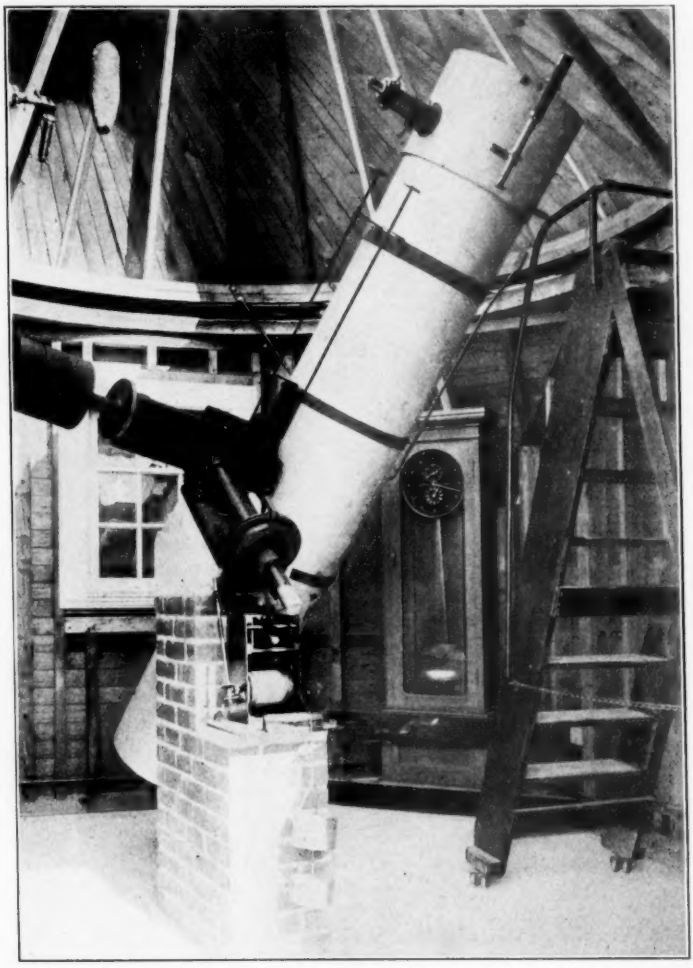
Here we can only pause in amazement and wonder at the sublimity and vastness of that great Cosmos in which our world is but a grain of sand and in which we are less than nothing. And our amazement and wonder would be followed by hopeless despair if we did not believe that the Absolute, the Eternal Reality, is after all the same Great Being to whom the hearts of man have turned instinctively since the dawn of humanity itself. Even now, from this whirling dust-grain in the infinite night, this atom in the sunlight, we can still assert that "the eternal God is our refuge and underneath are the Everlasting Arms."

OBSERVATORY AT ANTIETAM FARM, SMITHTOWN, LONG ISLAND.

R. BURNSIDE POTTER.

This brief account may be suggestive to amateurs who contemplate the purchase of a telescope, a little too large to be housed in one of the many ingenious make-shifts, so satisfactory for small instruments, which, at the same time, are not small enough to be easily portable. The writer, having used for several years, rubber tents, bathing houses

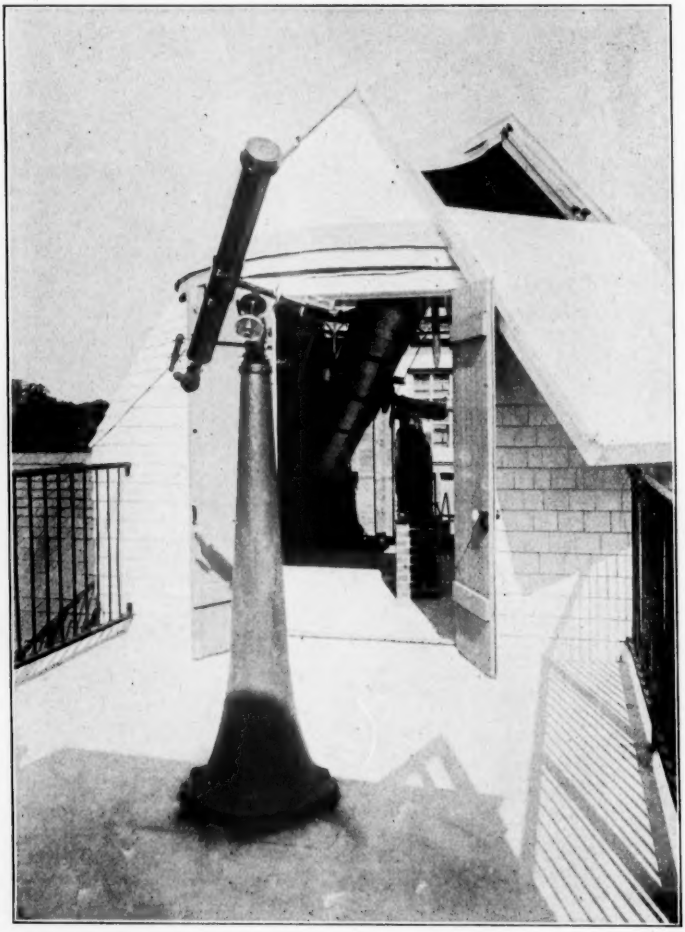
on wheels and collapsible contrivances of various kinds, seized the occasion, when he was building a new house, to erect an observatory, with revolving top, on the roof.



MR. POTTER'S REFLECTOR.

The structure was built almost exactly according to the plans and specifications given in Chambers' Handbook of Astronomy, except that the window for the transit instrument on one of the corners was

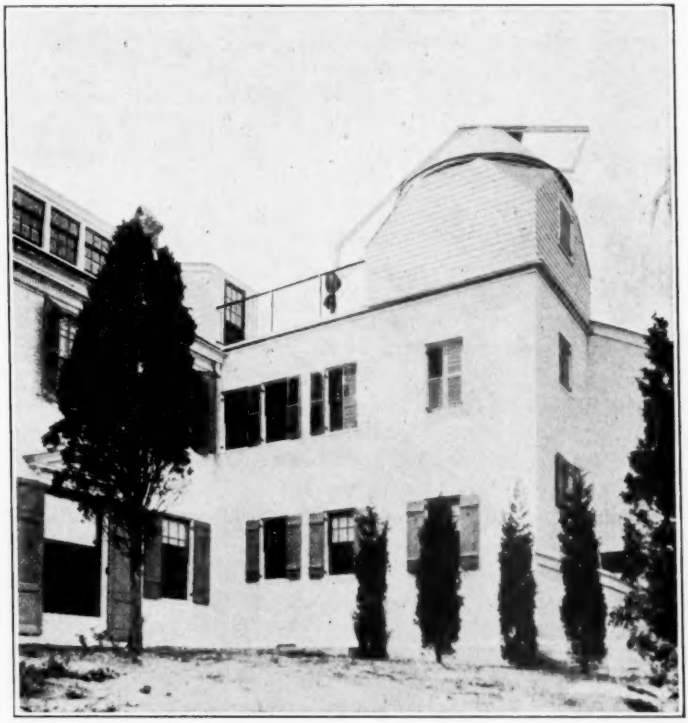
omitted, partly because it was impossible to obtain the correct oriental tion and partly because my "transit instrument" is a Steinheil Prism, used merely for obtaining the time, and as shown in the photographs



MR. POTTER'S $3\frac{9}{16}$-INCH REFRACTOR.

screwed into the jamb of the door, on the left. The room is eleven feet two inches square inside, and was intended to accommodate a refractor of about seven feet focus, but, while building operations were in progress, I became fascinated by the low prices of Mr. Mellish's reflectors and

determined to get a larger glass, without spending more money. In consequence the shutter opening was made wider and the roof timbers slightly stiffened, without any ill effects. The shutters have never leaked a drop, can be manipulated by a child and the whole "dome"



MR. POTTER'S OBSERVATORY.

revolves easily on its four cannon balls with a light pressure of one hand. It has one draw-back however. Objects nearer the horizon than about twenty-five degrees cannot be observed at all.

The main instrument is a 16-inch Mellish Newtonian of 115-inch focus (oculars by Zeiss, giving powers of from x36 to x580) and, as far as I am able to judge, its optical qualities are remarkable. Let me say here that, while it is theoretically true that no telescope can, with advantage, have applied to it a power of less than five for every inch of aperture, it is certainly not true in practice and the views I obtain of the nebulae with x36 are much finer than with x72 or x115.

The clockwork runs very smoothly but there was some misunderstanding between the maker and myself about it and I have been using it with the weight running over a pulley hooked to the sill of the "dome". This does not give enough fall and the clock has to be frequently rewound. I am now drilling a hole in the concrete floor and the weight will fall twenty feet or so down a stair well.

I would advise all amateurs, who have passed their "first small telescope" stage, especially those interested in planetary or lunar markings, or in the nebulae, to try a reflector. The bugaboo of the adjustments of the mirrors, with a little patience, will disappear. My first adjustment was made, with the assistance of a boy of fifteen, in less than an hour, using the daylight method given in the text books and, when the telescope was tried on a star, a few touches to the screws of the diagonal mirror brought forth a perfect image.

I was also worried about the effect of dew in my damp locality with an altitude of only 230 feet, but I find that with the instrument on top of a house, and if the latter is on high ground, there is no trouble whatever, even near the sea shore. Of course there is the question of resilvering, which I admit I have not yet satisfactorily settled, but luckily my speculum after six months still shows the "debilissimae" in Epsilon Lyrae, which is considered a test for the reflecting surface.

The auxiliary instrument is by Gaertner, with spring driving clockwork and Zeiss triplet $3\frac{9}{16}$ inch object glass. The equatorial is supposed to be carried indoors but, when in constant use, in good weather, it remains on its pier, as it is rather heavy to handle alone. It is then covered by a rubber bag as shown in one of the pictures.

The time-piece is a standard railroad station clock, regulated to sidereal time.

Two of the photographs show the observatory from the terrace on the south side which connects it with my studio in the attic of the main part of the building. The other gives a general view from the east.

I regret that I cannot give the cost of construction, which was included in the carpenter's contract for the rest of the house. I could no doubt get it from the builders, however, if any amateur were interested. Needless to say, it must have largely exceeded the figures given by Chambers, on account of the great advance in prices of labor and building material.

Since writing the above, I have heard from Mr. Chamber's that his new "*Astronomy*," which has not yet been put on sale in this country contains further information about observatories for amateurs, with improvements suggestsd by twenty years more experience. I believe that accurate estimates of cost of construction are also given, but, alas, I am afraid, we cannot come near them in America.

REPORT OF THE AMERICAN METEOR SOCIETY.

CHARLES P. OLIVIER.

Late in 1911, having become convinced that the time had come for coöperation in the study of meteors in America and being encouraged to make the attempt by several astronomers, letters were sent out to various persons whom the subject was likely to interest.

As a result of this a number signified their willingness to join and so the American Meteor Society came into being.

The members fall under two heads, first those who are members of the Society for Practical Astronomy, secondly all others. Those under the first head all belong to the Meteor Section of that society, and their results must therefore be credited to that organization. In passing I wish to express my indebtedness to that society, because through it at last it has become possible to get in touch with the amateur astronomers of America. While some work was done in 1911, still no serious attempt was made to start most of our members until the summer of 1912. To date we have reports from six of the fifteen enrolled, which furnish observations of 1436 meteors. About 1000 of these have plotted paths and full descriptions, for the rest more or less complete descriptions only are given. Several fire-balls, many telescopic meteors and others showing peculiar or interesting phenomena are included in these reports.

Only about half of our material has yet been worked up. However, already twenty-nine parabolic orbits have been computed, and I believe that, when all is worked up, no less than 60 radiants will be fixed with sufficient accuracy to justify the calculation of such orbits. The October meteors of 1911 and the August meteors of 1912 were particularly well observed.

One paper on the η Aquarid Meteors, by the author, appeared in A. J., No. 640, which was based on some of these observations. The accompanying table furnishes the date of observations, with corresponding lengths of time work was continued and the numbers of meteors seen, for each observer.

The purpose of the present report is not only to outline briefly what we have so far accomplished, but even more to invite the future coöperation of all who are interested in meteor work, whether amateurs or professionals. We cannot get at the root of the many interesting problems which arise in connection with meteors without more numerous and better observations than have so far been available. Only by the help of many observers can these be secured. No instruments are needed, only a good star map, ruler and watch, and even if one observes

Summary of Meteor Observations.

Observer	Station	Greenwich Mean Time				Observed	Meteors	Note
			h	m	h	m	m		
* A. P. C. Craig	Corona, Calif.	1912 July 21	22	5	—23	30	85	11	
	"	Aug. 10	21	20	23	50	120	31	Very clear
	"	11	19	0	21	40	160	32	Very clear
	"	Oct. 18	23	15	25	0		16	Not continuous
	"	Nov. 14	23	0	24	45	105	43	Very clear
	"	Misc., many telescopic.						43	
P. H. Graham	Univ. of Virginia	1911 Oct. 23	19	45	21	39	114	19	2 observers
* Jas. W. Hanahan	Winneboro, S. C.	1912 Aug. 10	15	0	17	40	160	42	Clear
	"	11	15	0	18	0		60	Clear except 30m
* Chas. P. Olivier	Univ. of Virginia	1911 May 2	18	15	21	10	175	24	Little cloud
	"	4	20	18	21	12	54	6	Cloud and haze
	"	5	19	31	21	24	115	21	Dawn at 21h
	"	July 28	16	0	19	10	180	32	Haze below 30°;9 of these seen by P.H.G.
	Decatur, Ga.	Oct. 17	16	25	20	10	225	51	Clear
	"	19	16	31	20	25	234	69	¾ clear; 9 of these seen by H.B.A.
	"	23	16	39	21	39	300	110	Very clear
	"	24	18	6	20	6	120	32	Very clear
	"	Nov. 15	20	33	23	3	150	33	Very clear
	"	16	18	26	21	38	180	52	Some haze
	"	1912 Apr. 22	20	18	21	48	90	12	Very clear
	"	May 13	18	15	21	35	210	24	Clear except 30m
	Univ of Virginia	Aug. 11	15	6	21	3	342	120	40% lost because of clouds
	"	12	16	10	21	16		112	Mostly clear
	"	13	16	10	18	50		37	Mostly clear
	Decatur, Ga.	Oct. 16	18	9	20	49	220	49	Some cloud
	"	Nov. 14	19	16	23	4	228	59	Clear
	"	Dec. 9	16	38	20	8	210	36	Slight haze
	"	13	16	48	20	0	228	45	Some smoke
J. Brookes Smith	Hampden-Sidney, Va.	1911 Nov. 16	18	30	20	10	100	17	
	"	1912 Apr. 18	19	30	21	5	95	14	Some cloud
	"	19	16	0	18	0	120	14	
* L. J. Wilson	Nashville, Tenn.	1912 Aug. 11	16	30	—20	55	235	89	Clear except 30m.
		Misc.						2	
Chas. P. Olivier		Misc.						79	
								1436	

* Members of the S. P. A.

very occasionally, still each night's work is totally independent and therefore is just as useful for most purposes as if the observer worked several nights in succession.

When we have secured several thousand observations, it is our purpose to publish the combined results and their full discussion in a single paper, each observer receiving, of course, full credit for his contributions. Meanwhile brief reports, like the present one, will be published at intervals.

In closing I desire to extend a hearty invitation to all in America who are interested in meteors to communicate with me on the subject and it will give me pleasure to answer fully any questions and explain our plans at length.

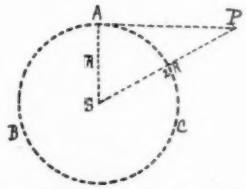
Agnes Scott College,
Decatur, Georgia.

THEOREM IN PLANETARY DYNAMICS.

LUIGI d'AURIA.

In the Journal of the Franklin Institute for October 1888, the following theorem was proved by the writer, which, he believes, is still unknown to most students of astronomy.

THEOREM.—The energy of the orbital motion of a planet revolving around the sun in a circular orbit, is equal to the energy the planet would acquire reaching its present distance from the sun, from a distance twice as large.



Denoting by m the planet's mass, by R the radius of its orbit, by M the mass of the sun, and by C the constant of gravitational attraction, the energy of orbital motion of the planet can be expressed by

$$E=C\,M\,m/2R. \qquad (1)$$

The expression for the energy which a mass m would acquire falling towards the sun from any distance $D>R$ to the distance R, is

$$E=C\,Mm\,(D-R)\,/DR; \qquad (2)$$

and this expression, it can be seen, becomes identical with the expression (1) when D=2R, which proves the above theorem.

As an illustration of the theorem, let S in the annexed figure present the sun, P the planet, and ABC the circumference of a circle described around S with a radius equal to one half the distance SP. If the planet, while attracted by the sun, were forced to move on the path PA tangent to ABC, it would reach the point A with a tangential velocity which would enable it to revolve around the sun in the circular orbit ABC.

PLANET NOTES FOR MARCH, 1913.

The sun will be moving northward and will cross the equator early in the morning of March 21. This is the time when spring begins, it being the time of the vernal equinox. The Sun will pass from the constellation Aquarius into the constellation Pisces during this month.

The phases of the moon for this month are as follows:

New Moon	Mar. 7 at 6 P. M.	C. S. T.
First Quarter	15 " 3 P. M.	"
Full Moon	22 " 6 A. M.	"
Last Quarter	29 " 7 A. M.	"

On the morning of March 22 just before the moon sets at Washington it will become totally eclipsed. The beginning of the eclipse will be visible here, but the moon will set before the end of the eclipse.

Mercury will reach a point of greatest eastern elongation on March 10. It will then be about one and one-third hours east and a few degrees north of the sun. It will be visible low in the west at sunset on this date. It will not remain visible for many days because on March 17 it stops moving eastward and begins to move toward the sun. On March 27 it passes the sun and will consequently be invisible in the rays of the sun.

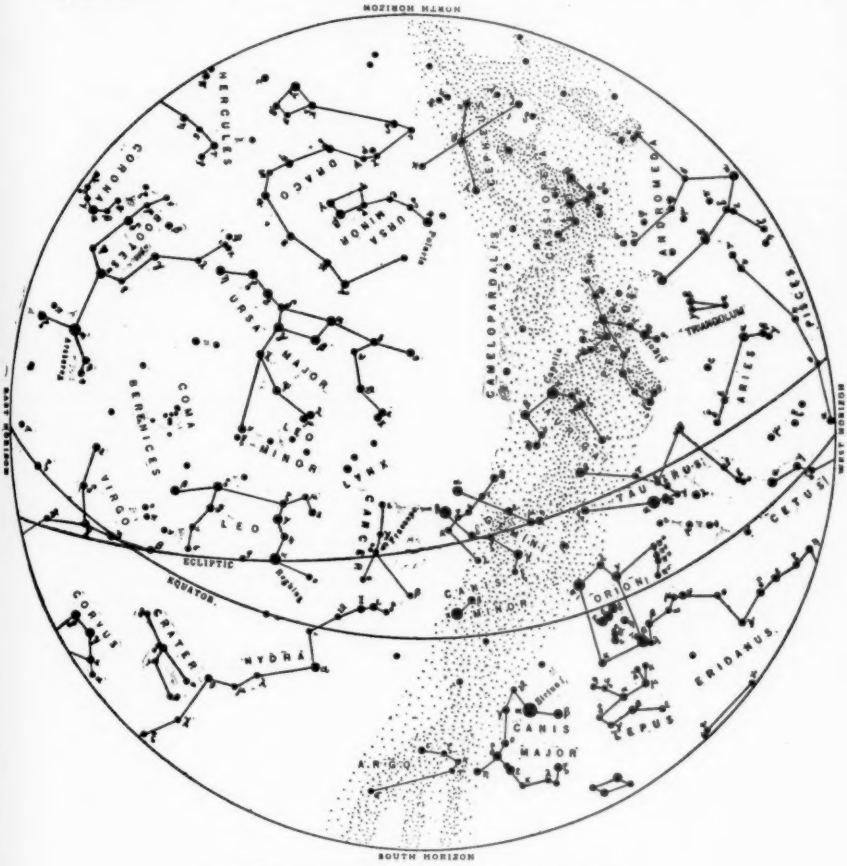
Venus, having been at a point of greatest elongation east on February 11, will still be nearly three hours east of the sun at the beginning of the month and about two hours east at the end. It will change during the month from twenty degrees north to eighteen degrees north of the sun. It will therefore still be quite conspicuous in the western sky. It attains its greatest brilliancy on March 19. It will then be of stellar magnitude —4.3.

Mars will be from two to two and a half hours west of the sun. It will also be several degrees south of the sun and will not be well situated for observation. It will be south east of the bright star Altair, and about thirty degrees directly south of Job's coffin in Delphinus. During the month it will be receding from the earth.

Jupiter will be west of Mars and will also be very far south. It will rise from three to five hours before the sun. It will be of stellar magnitude —1.6 and will be approaching the earth.

Saturn will still be visible early in the evening in the west throughout the month. It will be approaching the sun and by the end of the month will be only three hours from the horizon at sunset.

Uranus will rise a short time before the sun. It will be very far south and will be difficult to observe during the month. It will be in the constellation Capricornus.



THE CONSTELLATIONS AT 9:00 P. M. MARCH 1, 1913.

Neptune will be favorably situated being in the constellation Gemini. It will be near the meridian at sunset.

At sunset the constellation Orion will just have passed the meridian. Capella and Aldebaran will be prominent in the western sky, and Sirius, Procyon and Regulus in the eastern sky. Later at night Arcturus will be conspicuous in the east.

Occultations Visible at Washington.

Date 1913	Star's Name	Magnitude	IMMERSION. Washington M.T.	IMMERSION. Angle from N.	EMERSION. Washington M.T.	EMERSION. Angle from N	Duration
			h m	°	h m	°	h m
Mar. 3	56 B. Capricorni	6.3	16 48	73	18 0	266	1 12
12	47 Arietis	5.8	6 48	46	7 56	276	1 8
13	28 Tauri	5.2	5 36	135	6 15	189	0 39
17	ω Cancri	5.9	9 35	65	10 23	343	0 48
17	4 Cancri	6.2	10 2	113	11 13	296	1 11
19	34 Leonis	6.4	15 39	132	16 30	287	0 51
22	319 B, Virginis	6.3	11 4	71	11 40	11	0 36

Phenomena of Jupiter's Satellites..

1913	h	m			1913	h	m		
Mar. 2	15	56	III	Ec. Dis.	Mar. 20	16	37	III	Sh. Eg.
3	15	51	I	Ec. Dis.	26	15	39	IV	Tr. Eg.
4	15	20	I	Sh. Eg.	26	16	01	I	Ec. Dis.
4	16	29	I	Tr. Eg.	27	14	28	I	Tr. In.
11	14	45	II	Sh. In.	27	14	34	II	Ec. Dis.
11	14	57	I	Sh. In.	27	15	28	I	Sh. Eg.
13	14	34	II	Oc. Re.	28	14	01	I	Oc. Re.
19	14	07	I	Ec. Dis.	29	14	41	II	Tr. Eg.
20	14	51	I	Tr. Eg.	31	16	05	III	Oc. Re.

Note:—In., denotes ingress; Eg., egress; Dis., disappearance; Re., reappearance; Ec., eclipse; Oc., occultation; Tr., transit of the satellite; Sh., transit of the shadow.

VARIABLE STARS.

Approximate Magnitudes of Variable Stars on Jan. 1, 1913.

[Communicated by the Director of Harvard College Observatory, Cambridge, Mass.]

Name.	R. A. 1900. h m	Decl. 1900. ° ′	Magn.	Name.	R.A. 1900. h m	Decl. 1900. ° ′	Magn.
X Androm.	0 10.8	+46 27	12.4 *i*	RR Persei	21.7	+50 49	<13.0
T Androm.	17.2	+26 26	12.4	U Ceti	28.9	−13 35	<10.0
T Cassiop.	17.8	+55 14	9.7*d*	RR Cephei	29.4	+80 42	10.2 *i*
R Androm.	18.8	+38 1	8.6 *i*	R Trianguli	31.0	+33 50	11.7
S Ceti	19.0	− 9 53	10.7 *i*	T Arietis	42.8	+17 6	9.0
RW Androm.	41.9	+32 8	12.4	W Persei	43.2	+56 34	9.3
V Androm.	44.6	+35 6	<12.0	U Arietis	3 5.5	+14 25	11.0 *i*
RV Cassiop.	47.1	+46 53	9.6 *i*	X Ceti	14.3	− 1 26	8.5
W Cassiop.	49.0	+58 1	10.1 *i*	Y Persei	20.9	+43 50	8.4
U Androm.	1 9.8	+40 11	12.0 *i*	R Persei	23.7	+35 20	9.3
– Androm.	10.4	+41 12	11.7*d*	T Eridani	51.0	−24 20	<11.0
S Piscium	12.4	+ 8 24	12.9	W Tauri	4 22.2	+15 49	11.8
S Cassiop.	12.3	+72 5	<13.0	S Tauri	23.7	+ 9 44	<13.0
RZ Persei	23.6	+50 20	13.3	T Camelop.	30.4	+65 57	9.4 *i*
R Piscium	25.5	+ 2 22	8.4	RX Tauri	32.8	+ 8 9	<13.0
RU Androm.	32.8	+38 10	<13.0	X Camelop.	32.6	+74 56	12.7
Y Androm.	33.7	+38 50	<13.0	R Orionis	53.6	+ 7 59	10.4 *i*
R Arietis	2 10.4	+24 35	<11.0	R Leporis	55.0	−14 57	7.7
W Androm.	11.2	+43 50	<11.0	V Orionis	5 0.8	+ 3 58	10.2 *i*
Z Cephei	12.8	+81 13	<13.0	R Aurigae	9.2	+53 28	9.4*d*
o Ceti	14.3	− 3 26	8.4 *i*	S Aurigae	20.5	+34 4	9.3*d*
S Persei	15.7	+58 8	8.4	S Camelop.	30.2	+68 45	8.6
R Ceti	20.9	− 0 38	10.4*d*	U Aurigae	35.6	+31 59	11.2

Approximate Magnitudes of Variable Stars on Jan. 1, 1913.

Continued.

Name.	R. A. 1900. h m	Decl. 1900. ° ′	Magn.	Name.	R.A. 1900 h m	Decl. 1900 ° ′	Magn.
SU Tauri	43.2	+19 2	9.8	TZ Cygni	13.4	+50 0	10.7
Z Tauri	46.7	+15 46	13.3	U Lyrae	16.6	+37 42	10.7
U Orionis	49.9	+20 10	11.5	XZ Cygni	30.4	+56 10	10.3
V Camelop.	49.4	+74 30	<13.0	R Cygni	34.1	+49 58	9.0 *i*
Z Aurigae	53.6	+53 18	10.9	TT Cygni	37.1	+32 23	7.2
X Aurigae	6 4.4	+50 15	11.6	RT Cygni	40.8	+48 32	12.0
V Monoc.	17.7	− 2 9	11.0 *i*	χ Cygni	46.7	+32 40	9.7*d*
U Lyncis	31.8	+59 57	13.5 *i*	X Cygni	58.6	+49 46	<10.0
S Lyncis	35.9	+58 0	13.2	S Cygni	20 3.4	+57 42	12.9
R Lyncis	53.0	+55 28	9.3 *i*	SV Cygni	6.5	+47 35	9.2*d*
V Can.Min.	7 1.5	+ 9 2	<12.0	S Aquilae	7.0	+15 19	11.2*d*
R Gemin.	1.3	+22 52	8.5 *i*	RW Aquilae	7.3	+15 46	9.2
R Can.Min	3.2	+10 11	8.5	R Sagittae	9.5	+16 25	9.6
S Can.Min.	27.3	+ 8 32	9.6 *i*	RS Cygni	9.8	+38 28	7.6
U Can.Min.	35.9	+ 8 37	10.9*d*	R Delphini	10.1	+ 8 47	10.2 *i*
R Cancri	8 11.0	+12 2	11.0	SX Cygni	11.6	+30 46	11.6
V Cancri	16.0	+17 36	9.4 *i*	V Sagittae	15.8	+20 47	12.3
T Cancri	51.0	+20 14	8.8	U Cygni	16.5	+47 35	10.5 *i*
Y Draconis	9 31.1	+78 18	9.3	SZ Cygni	29.6	+46 16	9.3
R Leo.Min.	39.6	+34 58	7.3	ST Cygni	29.9	+54 38	10.1 *i*
R Leonis	42.2	+11 54	10.0	TV Cygni	30.0	+46 13	9.6
R Urs.Maj.	10 37.6	+69 18	12.0*d*	Y Delphini	36.9	+11 31	11.8
T Urs.Maj.	12 31.8	+60 2	8.6*d*	S Delphini	38.5	+16 44	8.4
RS Urs. Maj.	34.4	+59 2	11.9 *i*	V Cygni	38.1	+47 47	8.7
S Urs. Maj.	39.6	+61 38	8.2	T Delphini	40.7	+16 2	9.5
S Virginis	13 27.8	− 6 41	7.0	T Aquarii	44.7	− 5 31	7.5
T Urs. Min.	32.6	+73 56	12.7 *i*	RZ Cygni	48.5	+46 59	11.0
U Urs. Min.	14 15.1	+67 15	13.0	R Vulpeculae	59.9	+23 26	8.8*d*
R Can Ven.	44.6	+40 2	<11.0	RS Capric.	21 1.7	−16 49	8.2
S Bootis	19.5	+54 16	10.7*d*	X Cephei	3.6	+82 40	9.4
RS Virginis	22.3	+ 5 8	<11.0	R Equulei	8.4	+12 23	9.2*d*
V Bootis	25.7	+39 18	9.5*d*	T Cephei	8.2	+68 5	8.9*d*
R Camelop.	25.1	+84 17	12.4*d*	RR Aquarii	9.8	− 3 19	<12.0
R Bootis	32.8	+27 10	9.4*d*	W Cygni	32.2	+44 56	6.1*d*
S Urs. Min.	33.4	+78 58	9.1*d*	S Cephei	36.5	+78 10	11.0
X Herculis	15 59.6	+47 31	6.0	RU Cygni	37.3	+53 52	8.6
W Cor. Bor.	16 11.8	+38 3	<11.0	RV Cygni	39.1	+37 34	7.8
W Herculis	31.7	+37 32	<12.0	T Pegasi	22 4.0	+12 3	<13.0
R Draconis	32.4	+66 58	9.0*d*	RS Pegasi	7.4	+14 4	12.3
S Herculis	47.4	+15 7	8.4*d*	S Lacertae	24.6	+39 48	10.2
RV Herculis	56.8	+31 22	<12.0	R Lacertae	38.8	+41 51	<12.0
T Draconis	17 54.8	+58 14	<11.0	RW Pegasi	59.2	+14 46	12.4 *i*
V Draconis	56.3	+54 53	12.4*d*	R Pegasi	23 1.6	+10 0	9.1*d*
T Herculis	18 5.3	+31 0	7.9	V Cassiop.	7.4	+59 8	12.4
W Draconis	5.4	+65 56	11.6 *i*	W Pegasi	14.8	+25 44	<11.0
X Draconis	6.8	+66 8	12.0	ST Androm.	33.8	+35 13	9.4
W Lyrae	11.5	+36 38	7.7	R Aquarii	38.6	−15 50	10.2
SV Draconis	31.2	+49 18	<13.0	Z Cassiop.	39.7	+56 2	13.2
RY Lyrae	41.2	+34 34	<13.0	RR Cassiop.	50.7	+53 8	13.0
Z Lyrae	56.0	+34 49	<12.0	R Cassiop.	53.3	+50 50	12.7*d*
V Lyrae	19 5.2	+29 30	<12.0	Y Cassiop.	58.2	+55 7	10.7*d*
S Lyrae	9.1	+25 50	13.0	SV Androm.	59.2	+39 33	8.1

The letter *i* denotes that the light is increasing; the letter *d*, that the light is decreasing; the sign < that the variable is fainter than the appended magnitude.

The above magnitudes have been compiled at the Harvard College Observatory from observations made by the following observers:—H. C. Bancroft, T. C. H. Bouton, A.P.C. Craig, T. Dunham, Jr., E. L. Forsyth, C. E. Furness, E. Gray, F. E. Hathorn, S. E.Hunter, M.W. Jacobs Jr., J.B. Lacchini, F. C. Leonard, C. Y. McAteer, W.T. Olcott, P.G. O'Reilley, F. E. Seagrave, H. M. Swartz, D. Todd, H. W. Vrooman, J. M. White, I. E. Woods, and A. S. Young.

Minima of Variable Stars of Short Period.

[Calculated by Myrtle L. Richmond, E. R. Peterson and S. N. Stearns at Goodsell Observatory.]

Given to the nearest hour in Greenwich mean time; to obtain eastern Standard time subtract 5h; Central Standard 6h. etc.

Star	R. A. 1900		Decl. 1900		Magnitude	Approx. Period		Greenwich mean time of minima in **March** 1913							
	h	m	°	′		d	h	d	h	d	h	d	h	d	h
SY Androm.	0	08.0	+43	09	9.5—13.0	34	21.9			29	3				
RT Sculptor		31.5	−26	13	9.6—10.5	0	12.3	2	5;	9	21;	17	13;	25	6
UU Androm.		38.5	+30	24	10.7—11.9	1	11.7	7	14;	15	0;	22	11;	29	21
U Cephei	0	53.4	+81	20	7.0— 9.0	2	11.8	4	5;	11	17;	19	4;	26	16
Z Persei	2	33.7	+41	46	9.4—12	3	01.4	3	7;	9	9;	21	15;	27	17
RY Persei		39.0	+47	43	8.0—10.3	6	20.7	2	16;	9	12;	23	6;	30	3
RZ Cassiop.		39.9	+69	13	6.4— 7.8	1	04.7	7	9;	14	14;	21	18;	28	22
ST Persei		53.7	+38	47	8.5—10.5	2	15.6	3	8;	11	6;	19	5;	27	4
RX Cassiop.	2	58.8	+67	11	8.6— 9.1	32	07.6			10	21				
Algol	3	01.7	+40	34	2.3— 3.5	2	20.8	5	22;	11	14;	23	2;	28	20
RT Persei		16.7	+46	12	9.5—11.5	0	20.4	6	4;	12	23;	19	18;	26	13
λ Tauri		55.1	+12	12	3.4— 4.5	3	22.9	3	17;	11	15;	19	12;	27	10
RW Tauri	3	57.8	+27	51	7.1—<11	2	18.5	7	9;	15	17;	24	0		
RV Persei	4	04.2	+33	59	9.5—11.0	1	23.4	2	10;	8	8;	20	4;	26	3
RW Persei		13.3	+42	04	8.8—11.0	13	04.8	6	8;	19	12				
SZ Tauri		31.4	+18	20	7.2— 7.7	3	03.6	5	10;	11	17;	24	7;	30	14
RS Cephei	4	48.6	+80	06	9.5—12.0	12	10.1			8	15;	21	1		
TT Aurigae	5	02.8	+39	27	7.8— 8.7	0	16.0	5	5;	11	21;	25	5;	31	21
RY Aurigae		11.5	+38	13	10.7—11.7	2	17.5	2	14;	13	12;	24	10;	29	21
RZ Aurigae		42.9	+31	40	10.6—13.3	3	00.3	1	17;	13	18;	25	19;	31	19
SV Tauri		45.8	+28	05	9.4—11.0	2	04.0	6	23;	13	11;	19	23;	26	11
SV Gemin.	5	54.6	+24	28	9.8—<11	4	00.2	5	12;	13	12;	21	13;	29	13
RW Gemin.	5	55.4	+23	08	9.5—11.0	2	20.8	3	0;	14	11;	25	22;	31	15
U Columbae	6	11.2	−33	03	9.4—10.2	2	19.2	1	15;	12	19;	24	0;	29	15
SX Gemin.		22.0	+20	37	10.8—11.5	1	08.8	2	13;	13	12;	24	10;	29	21
RW Monoc.	6	49.4	−	7 28	9.8—10.5	0	21.5	3	17;	11	8;	18	23;	26	14
RX Gemin.		43.6	+33	21	8.8— 9.6	12	05.0			10	21;	23	2;		
RU Monoc.		29.3	+	8 54	9.0—10.8	1	21.7	3	17;	10	21;	18	2;	25	6
R Can. Maj.	7	14.9	−16	12	5.8— 6.4	1	03.3	4	11;	10	3;	21	12;	27	4
RY Gemin.		21.7	+15	52	8.9—<10	9	07.2	1	22;	11	5;	20	13;	29	20
Y Camelop.		27.6	+76	17	9.5— 12	3	07.3	3	2;	9	17;	22	22;	29	13
RR Puppis		43.5	−41	08	9.5—	6	10.3	4	14;	11	1;	23	21;	30	8
V Puppis	7	55.4	−48	58	4.1— 5.8	1	10.9	1	6;	8	13;	23	2;	30	8
X Carinae	8	29.1	−58	53	7.9— 8.7	0	13.0	1	0;	11	20;	22	16;	28	2
S Cancri		38.2	+19	24	8.2—10	9	11.6			10	0;	19	12;	29	0
S Antliae		27.9	−28	11	6.7— 7.8	0	07.8	4	5;	10	17;	23	16;	30	5
S Velorum		28.5	−44	46	7.8— 9..	5	22.4	6	7;	12	5;	24	2;	30	0
Y Leonis	9	31.1	+26	41	9.3—11.2	1	16.5	6	10;	14	20;	23	6;	31	17
RR Velorum	10	17.8	−41	36	10.0—10.9	1	20.5	6	13;	15	20;	25	2		
SS Carinae	10	54.2	−61	23	12.2—12.8	3	07.2	4	4;	10	19;	24	0;	30	14
ST Urs. Maj.	11	22.4	+45	44	6.7— 7.2	8	19.2	3	14;	12	10;	21	5;	30	0
RW Urs. Maj.		35.4	+52	34	9.3—10.3	7	07.9	3	3;	10	11;	17	18;	25	2
Z Draconis	11	40.6	+72	49	9.5—12.5	1	08.6	1	20;	8	15;	22	5;	29	0
SS Centauri	13	07.2	−63	37	8.8—10.4	2	11.5	1	10;	8	21;	23	18;	31	4
δ Librae	14	55·6	−	8 07	5. — 6.7	2	07.9	2	2;	9	2;	23	1;	30	1
U Coronae	15	14.1	+32	01	7.6— 8.7	3	10.9	7	6;	14	4;	21	1;	27	23
TW Draconis		32.4	+64	14	7.0— 8.9	2	19.4	5	15;	14	1;	22	11;	30	21
114.1908 Librae	15	43.4	−15	14	9.3—11.5	0	18.4	3	13;	11	5;	18	20;	26	12
SW Ophiuchi	16	11.1	−	6 44	9.2—10.0	2	10.7	2	11;	9	19;	24	11;	31	20
SX Ophiuchi		12.6	−	6 25	10.5—11.2	2	01.5	4	6;	12	12;	20	18;	29	1
R Arae		31.1	−56	48	6.7— 8.	4	10.2	3	23;	12	20;	21	16;	30	12

Minima of Variable Stars of Short Period.—Continued.

Star	R. A. 1900	Decl. 1900	Magnitude	Approx. Period	Greenwich mean times of minima in **March** 1913
	h m	° ′		d h	d h d h d h d h d h
TT Herculis	16 49.9	+17 00	8.9— 9.3	20 18.1	6 7; 17 9; 27 1
TU Herculis	17 09.8	+30 50	9.5—12	2 06.4	1 23; 8 19; 22 9; 29 7
U Ophiuchi	11.5	+ 1 19	6.0— 6.7	0 20.1	4 13; 12 22; 21 8; 29 14
u Herculis	13.6	+33 12	5.1— 5.6	2 01.2	5 9; 11 13; 23 20; 30 0
TX Herculis	15.4	+42 00	8.3— 9.0	1 00.7	5 13; 12 18; 19 23; 27 4
RV Ophiuchi	29.8	+ 7 19	9. —<11	3 16.5	7 17; 15 2; 22 11; 29 20
SZ Herculis	36.0	+33 01	9.5—10.3	0 19.6	1 17; 9 21; 18 2; 26 6
TX Scorpii	48.6	−34 13	7.5— 8.2	0 22.6	1 16; 9 5; 24 7; 31 20
Z Herculis	53.6	+15 09	7.1— 7.9	3 23.8	3 3; 11 2; 19 2; 27 2
WX Sagittae	53.6	—17 24	9.2—10.8	2 36.6	1 8; 7 18; 20 12; 26 22
WY Sagittae	17 54.9	—23 1	9.5—10.6	4 16.0	4 11; 13 20; 23 4; 27 20
SX Draconis	18 03.0	+58 23	9.3—10.5	5 04.1	3 23; 14 7; 24 16; 29 20
RS Sagittarii	11.0	−34 08	5.9— 6.3	2 10.0	8 4; 15 10; 22 16; 29 22
V Serpentis	11.1	−15 34	9.5—11.1	3 10.9	4 7; 11 4; 25 0; 31 22
RZ Scuti	21.1	− 9 15	7.4— 8.3	15 3.2	9 3; 24 6
RZ Draconis	21.8	+58 50	9.5—10.2	0 13.2	1 7; 12 7; 23 8; 28 20
RX Herculis	26.0	+12 32	7.0— 7.6	0 21.3	4 3; 13 0; 21 22; 30 19
SX Sagittarii	39.7	−30 36	8.6— 9.4	2 01.8	1 0; 7 5; 19 16; 25 22
RR Draconis	40.8	+62 34	8.5—<12	2 19.9	2 10; 10 22; 19 10; 27 22
RS Scuti	43.7	−10 21	9.3—10.3	0 15.9	1 19; 8 11; 21 18; 28 9
β Lyrae	46.4	+33 15	3.4— 4.5	12 21.8	10 4; 23 2
U Scuti	18 48.9	−12 44	9.0— 9.8	0 22.9	7 10; 16 23; 26 12
RX Draconis	19 01.1	+58 35	9.3—10.2	1 21.5	2 3; 9 17; 17 6; 24 20
RV Lyrae	12.5	+32 15	11. —13	3 14.4	6 1; 13 6; 20 11; 27 15
RS Vulpec.	13.4	+22 16	6.9— 8.0	4 11.4	9 7; 18 5; 27 4
U Sagittae	14.4	+19 26	6.7— 9.0	3 09.1	1 3; 7 21; 21 10; 28 4
Z Vulpec.	17.5	+25 23	7.3— 8.5	2 10.9	7 9; 14 17; 22 2; 29 11
TT Lyrae	24.3	+41 30	9.0—<11	5 05.8	5 17; 16 5; 26 16; 31 22
120.1907 Draconis	19 26.2	+68 44	9.3—10	1 15.1	3 10; 9 22; 22 23; 29 12
SY Cygni	19 42.7	+32 28	10 —12	6 00.2	1 5; 13 5; 25 6; 31 6
WW Cygni	20 00.6	+41 18	9.5—12.5	3 07.6	7 13; 14 4; 27 11; 3 2
SW Cygni	03.8	+46 01	9. —12	4 13.8	8 13; 17 17; 26 20
VW Cygni	11.4	+34 12	9.5—11.5	8 10.3	3 11; 11 21; 20 7; 28 18
RW Capric.	12.2	−17 59	8.8—10.6	3 09.4	6 16; 13 10; 20 5; 27 0
UW Cygni	19.6	+42 55	10.5—13	3 10.8	4 15; 11 12; 18 10; 25 8
V Vulpec.	32.3	+26 15	8.0— 9.0	37 19.0	23 7
W Delphini	33.1	+17 56	9.5—11.5	4 19.4	9 22; 19 12; 29 3
RR Delphini	38.9	+13 35	10.5—11.8	4 14.4	2 23; 12 4; 21 8; 30 13
Y Cygni	48.1	+34 17	7.1— 7.9	1 12.0	4 5; 11 17; 19 4; 26 16
WZ Cygni	49.3	+38 27	9.8—10.8	0 14.0	1 12; 13 5; 24 21; 30 18
RR Vulpec.	20 50.5	+27 32	9.6—11.0	5 01.2	5 18; 15 20; 24 23; 31 0
VV Cygni	21 02.3	+45 23	12.1—13.8	1 11.4	6 6; 13 15; 21 1; 28 10
AE Cygni	09.0	+30 20	10.8—11.4	0 23.3	2 8; 10 3; 17 21; 25 16
UZ Cygni	55.2	+43 52	9. —11.5	31 07.3	16 14
RT Lacertae	21 57.4	+43 24	9.1—10.5	5 01.7	5 19; 15 22; 26 2; 31 4
RW Lacertae	22 40.6	+49 08	10.2—11.2	5 04.4	2 4; 12 13; 22 22; 28 2
X Lacertae	22 45.0	+55 54	8.2— 8.6	5 10.6	2 5; 13 2; 24 0; 29 10
TT Androm	23 08.7	+45 36	10.5—11.3	2 18.3	9 4; 17 11; 25 18
Y Piscium	29.3	+ 7 22	9.0—12.0	3 18.4	8 10; 15 22; 23 11; 31 0
TW Androm	23 58.2	+32 17	8.6—11.5	4 02.9	5 21; 14 3; 22 9; 30 15

Maxima of Variable Stars of Short Period.

[Calculated by May E. Abbott, Hazel H. Barnard, Helen A. Orr, and Myrtle L. Richmond at Goodsell Observatory.]

Given to the nearest hour in Greenwich mean time. To obtain Eastern standard time subtract 5^h; Central standard time 6^h etc.

Star	R.A. 1900 h m	Decl. 1900 ° ′	Magnitude	Approx. Period d h	Greenwich mean times of maxima in March 1913. d h d h d h d h
SX Cassiop.	0 05.5	+54 20	8.6— 9.4	36 13.7	22 23
SV Cassiop.	0 09.8	+57 52	9.3— 9.9	4 1.7	5 16; 13 19; 21 22; 30 2
RR Ceti	1 27.0	+ 0 50	8.3— 9.0	0 13.3	3 19; 11 13; 19 6; 27 0
RW Cassiop.	1 30.7	+57 15	8.9—11.0	14 19.2	3 2; 17 22
V Arietis	2 09.6	+11 46	8.3— 9.0	0 23.8	2 7; 10 5; 18 4; 26 2
SU Cassiop.	2 43.0	+68 28	6.5— 7.0	1 22.8	5 17; 13 12; 21 7; 29 2
TU Persei	3 01.8	+52 49	11.4—12.2	0 14.6	4 9; 11 16; 18 23; 26 6
RW Camelop.	3 46.2	+58 21	8.2— 9.4	16 00.0	14 0; 30 0
SX Persei	4 10.2	+41 27	10.4—11.2	4 06.9	9 3; 17 17; 26 7
SV Persei	42.8	+42 07	8.8— 9.6	11 03.1	6 19; 17 22; 29 1
RX Aurigae	4 54.5	+39 49	7.2— 8.1	11 15.0	11 14; 23 5
SX Aurigae	5 04.6	+42 02	8.0— 8.7	1 12.8	2 4; 9 20; 17 12; 25 4
SY Aurigae	05.5	+42 42	8.4— 9.5	10 03.3	3 9; 13 13; 23 17
Y Aurigae	21.6	+42 21	8.6— 9.6	3 20.6	8 8; 16 1; 23 19; 31 12
RZ Gemin.	5 56.6	+22 15	9.1—10.0	5 12.7	6 9; 11 22; 22 23; 28 12
RS Orionis	6 16.5	+14 43	7.8— 8.5	7 13.4	3 16; 11 6; 18 19; 26 9
T Monoc.	19.8	+ 7 08	5.7— 6.8	27 00.3	17 6
RZ Camelop.	23.7	+67 06	11.0—13.0	0 11.5	1 0; 8 5; 22 15; 29 20
W Gemin.	29.2	+15 24	6.8— 7.6	7 22.0	1 17; 9 15; 17 13; 25 11
ζ Gemin.	6 58.2	+20 43	3.7— 4.5	10 03.7	2 19; 12 23; 23 3
RU Camelop.	7 10.9	+69 51	8.5— 9.8	22 06.5	20 0
RR Gemin.	7 15.2	+31 04	10.0—11.5	0 09.5	7 16; 15 15; 23 14; 31 12
V Carinae	8 26.7	−59 47	7.2— 8.0	6 16.7	6 21; 13 13; 20 6; 26 23
T Velorum	8 34.4	−47 01	7.5— 8.5	4 15.3	2 0; 11 6; 20 13; 29 20
W Carinae	9 19.2	−55 32	7.5— 8.5	4 08.9	7 0; 15 18; 24 12
W Ursae Maj.	9 36.7	+56 24	7.9— 8.6	0 04.0	5 14; 12 6; 18 23; 24 15
RR Leonis	10 02.1	+24 03	9.1—10.1	0 10.9	5 14; 12 9; 19 3; 25 22
SW Draconis	11 32.2	+67 53	8.9— 9.6	0 16.0	5 12; 12 3; 25 8; 31 22
S Muscae	12 07.4	−69 36	6.5— 7.3	9 15.8	1 17; 11 9; 21 1; 30 16
SU Draconis	12.8	+70 04	8.8— 9.6	0 13.7	6 5; 14 5; 22 4; 30 4
T Crucis	15.9	−61 44	6.8— 7.6	6 17.6	1 9; 8 3; 21 14; 28 7
R Crucis	18.1	−61 04	6.8— 8.0	5 19.8	5 21; 11 17; 23 9; 29 5
S Crucis	48.4	−57 53	6.6— 7.8	4 16.6	2 9; 11 18; 21 3; 30 12
RZ Centauri	12 55.6	−64 05	8.5— 8.9	1 21.0	6 17; 14 6; 21 18; 29 6
W Virginis	13 20.9	− 2 52	8·7—10.4	17 06.5	14 5; 31 11
RV Ursae Maj.	13 29.4	+54 31	9.2— 9.9	0 11.2	7 7; 14 8; 21 8; 28 9
ST Virginis	14 22.5	− 0 27	10.3—11.4	0 09.9	7 11; 15 16; 23 21
V Centauri	25.4	−56 27	6.4— 7.8	5 11.9	5 16; 11 4; 22 4; 27 17
RS Bootis	29.3	+32 11	8.9—10.0	0 09.1	1 5; 8 18; 23 20; 31 9
RU Bootis	14 41.5	+23 44	12.8—14.3	0 11.9	3 2; 10 12; 17 22; 25 8
R Triang. Austr.	15 10.8	−66 08	6.7— 7.4	3 09.3	7 13; 14 7; 21 2; 28 21
S Triang. Austr.	15 52.2	−63 29	6.4— 7.4	6 07.8	1 23; 8 7; 20 22; 27 6
S Normae	16 10.6	−57 39	6.5— 7.4	9 18.1	10 10; 20 4; 29 22
RW Draconis	33.7	+58 03	9.6—10.8	0 10.6	7 14; 16 11; 25 7
RV Scorpii	16 51.8	−33 27	6.7— 7.4	6 01.5	6 9; 12 10; 24 13; 30 15
X Sagittarii	17 41.3	−27 48	4.4— 5.0	7 00.3	3 1; 10 1; 24 2; 31 2
Y Ophiuchi	47.3	− 6 07	6.1— 6.5	17 02.9	12 20; 29 23
W Sagittarii	17 58.6	−29 35	4.3— 5.1	7 14.3	3 23; 11 14; 19 4; 26 18
Y Sagittarii	18 15.5	−18 54	5.4— 6.2	5 18.6	1 5; 12 19; 24 8; 30 2

Maxima of Variable Stars of Short Period.—Continued.

Star	R. A. 1900	Decl. 1900	Magnitude	Approx. Period	Greenwich mean times of maxima in March 1913.							
	h m	° ′		d h	d	h	d	h	d	h	d	h
U Sagittarii	18 26.0	−19 12	6.5— 7.3	6 17.9	4	18;	11	12;	25	0;	31	18
Y Scuti	32.6	− 8 27	8.7— 9.2	10 08.3	8	6;	18	14;	28	22		
Y Lyrae	34.2	+43 52	11.3—12.3	0 12.1	5	1;	11	2;	23	4;	29	5
RZ Lyrae	39.9	+32 42	9.9—11.2	0 12.3	3	16;	9	19;	22	2;	28	5
RT Scuti	44.1	−10 30	9.1— 9.7	0 11.9	1	15;	13	12;	25	10;	31	8
κ Pavonis	18 46.6	−67 22	3.8— 5.2	9 02.2	2	18;	11	20;	20	22;	30	1
U Aquilae	19 24.0	− 7 15	6.2— 6.9	7 00.6	1	4;	8	4;	22	5;	29	6
XZ Cygni	30.4	+56 10	8.7— 9.3	0 11.2	5	13;	12	13;	19	13;	26	13
U Vulpec.	32.2	+20 07	6.9— 7.6	7 23.5	7	4;	15	4;	23	3;	31	3
SU Cygni	40.8	+29 01	6.6— 7.4	3 20.3	5	19;	13	12;	21	4 ;	28	21
η Aquilae	47.4	+ 0 45	3.7— 4.5	7 04.2	2	4;	9	8;	23	16;	30	21
S Sagittae	51.5	+16 22	5.6— 6.4	8 09.2	4	7;	12	16;	21	1;	29	11
X Vulpec.	19 53.3	+26 17	9.5—10.5	6 07.7	6	17;	13	1;	19	8;	25	16
XX Cygni	20 01.3	+58 40	10.5—11.5	0 03.2	2	14;	9	8;	22	19;	29	13
X Cygni	39.5	+35 14	6.0— 7.0	16 09.3			14	23;	31	8		
T Vulpec.	47.2	+27 52	5.5— 6.5	4 10.5	2	12;	11	9;	20	6;	29	3
WY Cygni	52.3	+30 03	9.5—10.3	0 13.5	2	20;	9	13;	23	0;	29	18
RV Capric.	55.9	−15 37	9.2—10.1	0 10.7	4	13;	11	6;	24	16;	31	9
TY Cygni	20 56.4	+42 12	8.5— 9.7	14 17.4			13	21;	28	14		
VY Cygni	21 00.4	+39 34	8.9 — 9.5	7 20.6	2	0;	9	21;	17	18;	25	14
VZ Cygni	21 47.7	+42 40	8.4— 9.2	4 20.7	2	5;	12	0;	21	17;	31	11
Y Lacertae	22 05.2	+50 33	9.1— 9.6	4 07.8	3	9;	12	0;	20	16;	29	8
δ Cephei	25.5	+57 54	3.7— 4.6	5 08.8	4	22;	15	16;	26	10;	31	18
Z Lacertae	36.9	+56 18	8.2— 9.0	10 21.1	8	11;	19	8;	30	5		
RR Lacertae	37.5	+55 55	8.5— 9.2	6 10.1	6	0;	12	11;	25	7;	31	17
V Lacertae	22 44.5	+55 48	8.2— 8.9	4 23.6	3	18;	13	18;	23	17;	28	16
SW Cassiop.	23 03.7	+58 11	9.2— 9.7	5 10.6	5	21;	11	8;	22	5;	27	15
RS Cassiop.	32.6	+61 52	9.1—10.0	6 07.1	5	9;	11	16;	24	6;	30	14
RY Cassiop.	47.2	+58 11	9.2—10.0	12 03.4	4	16;	16	20;	28	23		
U Pegasi	23 52.9	+15 24	9.3— 9.9	0 04.5	4	12;	12	0;	19	12;	27	0

The Algol System, Z Draconis.—In the "Contributions from the Princeton University Observatory, No. 2," Mr. R. S. Dugan presents an extensive treatment of this variable. The elements assigned to this star from this investigation are:

$$\text{Min.} = 2418388^{d}.6322 + 1^{d}.3574184\ E.$$

The writer expresses the opinion that other terms are necessary in the formula to represent the variation exactly. The elements given do not differ very much from those given to this star by A. A. Nijland in *A. N.* 4211.

Observations of Nova (2) Geminorum.—I give below a continuation of my observations of the Nova (2) Geminorum. The observations follow those published in POPULAR ASTRONOMY for January, 1913, No. 201. The telescope used in making these observations was the 3-inch instrument, with the exception of the ast two, (1912, Dec. 31 and 1913, Jan. 8), in which my new 4-inch equatorial refractor was employed.

OBSERVATIONS OF NOVA (2) GEMINORUM

1912, Nov. 15-1913, Jan. 8.

Date	Mag.	Color	Comparison Stars
1912			
Nov. 15	8.0	Very light greenish blue	BD.+32° 1433, 1434, 1437
Nov. 17	7.6	Very pale greenish blue	BD.+32° 1433 and 1437
Nov. 22	7.7	Very light greenish blue	BD.+32° 1433, 1434, 1437
Nov. 28	7.7	Very pale greenish blue	BD.+32° 1433, 1434, 1437
Nov. 29	8.0	Very light greenish blue	BD.+32° 1433, 1434, 1437
Dec. 4	7.7	Very light greenish blue	BD.+32° 1433, 1434, 1437
Dec. 5	7.7	Very light greenish blue	BD.+32° 1433, 1434, 1437
Dec. 6	7.9	Very light greenish blue	BD.+32° 1433, 1434, 1437
Dec. 8	7.6	Very pale greenish blue	BD.+32° 1433, 1434, 1437
Dec. 9	7.8	Very pale greenish blue	BD.+32° 1433, 1434, 1437
Dec. 11	7.9	Very light greenish blue	BD.+32° 1433, 1434, 1437
Dec. 13	7.9	Very light greenish blue	BD.+32° 1433, 1434, 1437
Dec. 14	7.9	Very light greenish blue	BD.+32° 1433, 1434, 1437
Dec. 21	8.1	Very light greenish blue	BD.+32° 1433, 1434, 1437
Dec. 22	8.1	Very light greenish blue	BD.+32° 1433, 1434, 1437
Dec. 23	8.1	Very light greenish blue	BD.+32° 1433, 1434, 1437
Dec. 25	8.1	Very light greenish blue	BD.+32° 1433, 1434, 1437
Dec. 27	8.0	Very light greenish blue	BD.+32° 1433, 1434, 1437
Dec. 28	8.0	Very light greenish blue	BD.+32° 1433, 1434, 1437
Dec. 31	8.1	Very light greenish blue	BD.+32° 1433, 1434, 1447
1913			
Jan. 8	8.1	Very light greenish blue	BD.+32° 1433, 1434, 1447

The additional comparison star in the last two observations of this set is BD.+32° 1447, Harvard magnitude 8.2. The Harvard magnitudes of two other comparison stars, namely BD.+33° 1433 ,and 1434 are respectively magnitudes 6.9 and 8.8. Cloudy weather prevented any observations of the Nova between 1912, Dec. 14 and 21, and also between 1912, Dec. 31 and 1913, Jan. 8.

It is seen from the table that throughout this entire period the Nova has been comparatively in a state of quiescence, (its variations in brilliancy not exceeding 0.5 of a magnitude). The color has remained practically unchanged, and from 1912, Dec. 21 through 1913, Jan. 8, the magnitude has been either 8.1 or 8.0, but mostly 8.1. The mean magnitude of the star from these twenty-one observations is approximately 7.9. This is perceptibly lower than that for the preceding period, (1912, Aug. 31–Nov. 15; see *P.A.* 201, pp. 50-51), *viz.*, magnitude 7.75. In fact, during the past few weeks the Nova has been generally fainter by several tenths of a magnitude than it had been. Its greatest activity in the course of the present observations occurred about the very beginning of them, when it was at its brightest. Its variations during this time, however, never amounted to more than 0.2 magnitude in 24 hours.

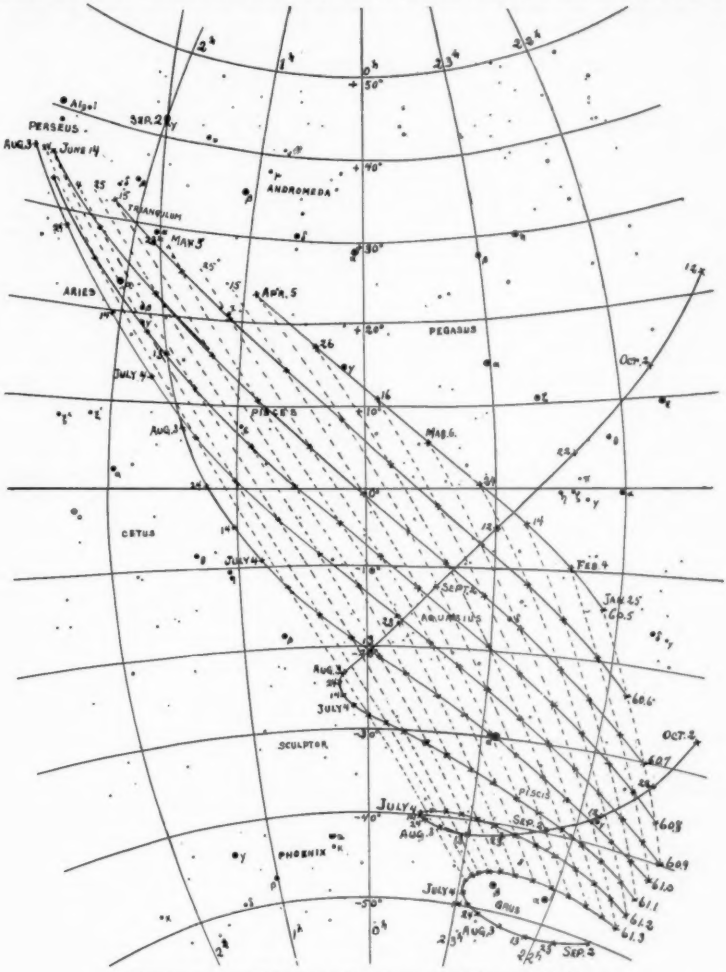
FREDERICK C. LEONARD.

1338 Madison Park, Chicago, Ill.,
1913, January 12.

COMET AND ASTEROID NOTES.

Search Ephemerides for Westphal's Comet 1852 IV.—In *A. N.* 4619 Mr. Adolf Hnatek gives extensions of his search ephemerides for Westphal's periodic comet for the current year. These are given in the tables which follow. The accompanying diagram shows in general the portion of the sky which must be

searched by those who would find the comet. The most probable period, derived from the observations at the apparition of 1852, is 61.0 years. As the uncertainty is about a year, the approximate paths of the comet have been calculated upon the assumptions of periods of 60.5, 60.6, 60.7, 60.8, 60.9, 61.0, 61.1, 61.2 and 61.3 years



REGION OF THE SKY TO BE SEARCHED FOR WESTPHAL'S COMET.

and these numbers on the chart indicate the curves which the comet will follow across the sky on the various assumptions. Dotted lines connect the points on the different curves corresponding to the same date. From January to June the apparent courses are northeasterly and roughly parallel, but after that they diverge so rapidly that it appeared impracticable to draw the dotted lines connecting the same

dates on the different curves. On January 25 the searcher should look along a line about 40° long extending through the southern constellations Aquarius, Pisces and Microscopium. On June 14 the dotted line extends from Perseus southwesterly, through Aries, Pisces, Cetus and Sculptor to Grus.

Should the period be exactly 61.0 years the comet will be north of the equator after July 24 and moving rapidly northward during August and September. Its calculated brightness will be greater than that of a fifth magnitude star, so that it should be easily picked up with the aid of field-glasses. A change of 0.1 of a year in the period here produces a large difference in the course of the comet, so that it will be necessary to search all over the northern heavens, especially in the six hours of right ascension on either side of 0^h.

Is is to be hoped that southern observers may catch sight of the comet while it is in the region where the daily area to be searched is short.

Search Ephemeris for Comet 1852 IV (Westphal).

[From *Astronomische Nachrichten* No. 4619.]

1913	Period = 60.5 years α 1913.0	δ 1913.0	Period = 60.6 years. α 1913.0	δ 1913.0	Period = 60.7 years α 1913.0	δ 1913.0
	h m	° ′	h m	° ′	h m	° ′
Jan. 25	22 8.7	—14 1	21 51.0	—23 22	21 34.5	30 24
Feb. 4	27.8	9 33	22 9.0	19 49	21 51.8	27 30
14	22 48.1	− 4 46	27.6	15 56	22 9.4	24 26
24	23 9.4	+ 0 21	22 46.7	11 47	27.2	21 8
Mar. 6	32.1	5 47	23 6.8	7 20	22 45.4	17 35
16	23 56.7	11 32	27.4	− 2 32	23 4.0	13 46
26	0 23.6	17 31	23 49.2	+ 2 38	23.1	9 42
Apr. 5	0 55.7	+23 36	0 12.6	8 8	23 42.8	5 16
16			0 38.1	13 58	0 3.4	− 0 25
25			1 6.3	20 1	25.7	+ 4 52
May 5			1 38.0	26 8	0 49.8	10 32
15			2 14.2	+32 4	1 16.0	16 33
25					1 45.3	22 49
June 4					2 18.9	29 9
14					2 57.8	35 15
24					3 43.1	+40 41

	Period = 60.8 years α 1913.0	δ 1913.0	Period = 60.9 years α 1913.0	δ 1913.0	Period = 61.0 years α 1913.0	δ 1913.0
	h m	° ′	h m	° ′	h m	° ′
Jan. 25	21 19.0	−35 50	21 4.3	−40 7	20 50.3	—43 35
Feb. 4	35.8	33 30	20.7	38 14	21 6.3	42 4
14	21 52.7	31 2	37.0	36 16	22.2	40 30
24	22 9.7	28 25	21 53.5	34 13	38.2	38 53
Mar. 6	26.9	25 39	22 9.9	32 3	21 54.0	37 13
15	22 44.2	22 41	26.3	29 47	22 9.7	35 30
26	23 1.8	19 30	42.8	27 20	25.3	33 44
April 5	19.6	16 4	22 59.1	24 48	40.7	31 54
15	37.6	12 21	23 15.5	22 7	22 56.1	30 0
25	23 56.3	8 18	32.0	19 11	23 11.1	28 2
May 5	0 15.7	− 3 51	23 48.6	16 2	25.5	25 59
15	36.0	+ 1 2	0 5.6	12 34	40.1	23 48
25	0 57.7	6 24	22.8	8 45	23 54.4	21 26
June 4	1 21.4	12 19	40.6	− 4 28	0 8.4	18 54
14	1 47.8	18 44	0 59.2	+ 0 24	22.1	16 7
24	2 18.0	25 34	1 19.1	5 57	35.5	12 57
July 4	2 53.4	32 35	1 40.8	12 21	0 48.6	9 18
14	3 35.8	39 20	2 5.2	19 40	1 1.3	− 4 54
24	4 26.5	+45 13	2 34.0	27 56	13.5	+ 0 29
Aug. 3			3 10.4	36 54	25.4	7 7
13			3 57.2	46 1	36.9	15 55
23			4 55.1	+53 41	1 48.4	27 53
Sept. 2					2 0.3	42 13
12					14.2	58 7
22					2 36.6	+73 17

		Period = 61.1 years		Period = 61.2 years		Period = 61.3 years	
		α 1913.0	δ 1913.0	α 1913.0	δ 1913.0	α 1913.0	δ 1913.0
		h m	° ′	h m	° ′	h m	° ′
Jan.	25	20 36.9	−46 25	20 24.0	−48 46	20 11.6	−50 44
Feb.	4	20 52.5	45 12	39.3	47 48	26.5	49 58
	14	21 8.1	43 57	20 54.5	46 50	41.3	49 14
	24	23.6	42 43	21 9.5	45 53	20 56.0	48 32
Mar.	6	38.9	41 27	24.4	44 58	21 10.3	47 53
	16	21 54.0	40 11	38.9	44 3	24.3	47 15
	26	22 8.8	38 56	21 53.1	43 11	37.9	46 43
Apr.	5	23.4	37 39	22 7.0	42 20	21 50.9	46 15
	15	37.5	36 24	20.1	41 35	22 3.4	45 53
	25	22 51.3	35 8	32.8	40 56	15.1	45 38
May	5	23 4.6	33 48	44.8	40 22	25.9	45 31
	15	17.9	32 32	22 56.0	39 53	35.8	45 33
	25	29.9	31 22	23 6.1	39 32	44.0	45 47
June	4	40.9	30 17	15.0	39 21	50.8	46 11
	14	50.7	29 20	22.3	39 19	55.6	46 48
	24	23 59.6	28 21	27.7	39 28	57.9	47 37
July	4	0 6.9	27 13	30.5	39 43	56.9	48 37
	14	11.9	25 50	30.0	40 5	52.1	49 42
	24	14.1	24 27	26.3	40 33	42.7	50 45
Aug.	3	0 12.3	22 45	15.9	41 5	28.3	51 35
	13	23 58.5	20 29	23 0.5	41 25	22 9.2	51 56
	23	43.7	17 10	22 39.5	40 53	21 46.9	51 29
Sept.	2	23 27.7	12 16	22 15.6	39 40	24.0	50 6
	12	22 59.2	− 5 12	21 48.2	36 22	21 3.6	47 44
	22	22 22.0	+ 3 56	24.7	32 6	20 47.7	44 32
Oct.	2	21 43.7	13 45	21 6.3	26 50	37.3	40 44
	12	21 10.0	22 34	20 54.2	20 59	32.4	36 33
	22	20 44.3	29 45	48.3	14 42	32.2	32 8
Nov.	1	26.7	35 34	47.4	8 6	36.1	27 37
	11	20 16.5	+40 34	50.7	− 1 44	43.3	23 0
	21			20 58.0	+ 3 54	20 53.3	18 17
Dec.	1			21 8.2	9 20	21 5.5	13 27
	11			21.4	14 59	19.7	8 27
	21			21 37.3	+21 2	35.6	− 3 15
	31					21 53.3	+ 2 11

NOTES FOR OBSERVERS.

Monthly Report of the American Association of Variable Star Observers, Dec.-Jan. 1912-13.—In spite of adverse weather conditions all over the country we have a very creditable report this month.

The variables that command special attention in this report are 235939 SV Andromedae, where the observations by Miss Young indicate a rise of 1.4 magnitudes in four days, and 001838 R Andromedae which rose approximately two magnitudes in a month. This variable, according to Hartwig, has a range of eight magnitudes, with a mean period of 411 days. It was discovered at Bonn in 1858, and its spectrum is a remarkable one of the third type. 141567 U Urs. Min. and 245381 U Cephei are noteworthy examples of rapidly waxing stars, and specially interesting to observe.

064932 Nova Geminorum(2) continues to wane slowly, approximately 8.2 magnitudes at this writing. A new chart of this field has been prepared by the Harvard College Observatory, with revised values for the comparison stars.

Variable Star Observations Dec.–Jan. 1912-13.

001726
T Androm.

Mo.	Day	Est.	Obs.
12	7	11.0	G
	12	12.3	Y
	23	11.2	G

001755
T Cassiop.

Mo.	Day	Est.	Obs.
12	3	9.3	Bu
	5	8.7	L
	6	9.9	C
	8	9.6	Bu
	9	9.5	J
	10	9.9	C
	12	8.9	Y
	15	9.6	Bu
	20	9.6	J
	25	9.8	Bu
	25	9.5	J
	26	9.2	B
	28	9.9	J
	28	9.7	S
1	4	9.5	Ba

001838
R Androm.

Mo.	Day	Est.	Obs.
12	8	9.6	V
	13	9.4	V
	25	8.8	V
1	8	7.0	Hu
	9	7.5	O

003179
Y Cephei

Mo.	Day	Est.	Obs.
12	15	10.5	Hu

004047
U Cassiop.

Mo.	Day	Est.	Obs.
12	4	10.9	L
	6	9.4	G
	12	11.4	Y
	15	11.3	L
	16	11.4	Y
	17	9.5	G
	24	9.2	G
	28	9.5	G
	30	9.6	G
	31	9.6	G
1	8	9.3	O

004435
V Androm.

Mo.	Day	Est.	Obs.
1	1	10.7	O
	8	10.0	O
	8	10.0	Hu

004533
RR Androm.

Mo.	Day	Est.	Obs.
1	1	10.5	O
	8	10.0	O
	8	9.8	Hu

004746
RV Cassiop.

Mo.	Day	Est.	Obs.
12	15	10.7	L

004958
W Cassiop.

Mo.	Day	Est.	Obs.
12	9	10.8	J
	12	10·9	J
	13	10.8	J
	20	10.7	J
	25	10.7	J
	28	10.6	J
1	5	10.7	J
	8	10.8	O

011208
S Piscium

Mo.	Day	Est.	Obs.
12	12	12.3	Y

012502
R Piscium

Mo.	Day	Est.	Obs.
12	12	8.8	Y
	16	8.7	Y

013338
Y Androm.

Mo.	Day	Est.	Obs.
12	9	12.6	J

014958
X Cassiop.

Mo.	Day	Est.	Obs.
12	5	10.8	L

021024
R Arietis

Mo.	Day	Est.	Obs.
1	1	11.3	O
	8	10.8	O

021258a
T Persei

Mo.	Day	Est.	Obs.
	6	9.2	C
	10	9.2	C
1	4	8.6	Ba

021403
***o* Ceti**

Mo.	Day	Est.	Obs.
12	3	8.6	F
	3	9.3	L
	4	9.0	G
	4	8.9	V
	6	9.2	C
	8	8.9	L
	9	9.0	L
	10	9.0	C
	11	8.8	V
	12	9.0	O
	15	9.0	O
	15	8.9	L
	25	8.8	G
	26	8.8	O
	27	9.0	V
	30	8.8	G
	31	8.7	G
1	1	9.0	O
	3	8.5	F
	8	7.3	Hu
	9	8.5	O

021658
S Persei

Mo.	Day	Est.	Obs.
12	6	9.1	C
	10	8.7	C
	17	8.5	G
	24	8.3	G
	26	8.4	G
	31	8.5	G
1	2	8.4	G
	4	8.4	Ba

022000
R Ceti

Mo.	Day	Est.	Obs.
	3	8.6	G

022813
U Ceti

Mo.	Day	Est.	Obs.
1	4	12.8	Ba

023133
R Trianguli

Mo.	Day	Est.	Obs.
12	12	11.2	Y

024356
W Persei

Mo.	Day	Est.	Obs.
	4	9.0	V
	6	9.2	C
	7	9.0	Hu
	8	9.2	Le
	9	9.2	Le
	10	9.2	C
	11	9.0	V
	11	9.3	Le
	12	9.2	Le
	13	9.2	Le
	14	9.2	Le
	15	9.2	O
	17	9.0	G
	21	9.2	Le
	22	9.2	Le
	23	9.1	Le
	24	9.2	Le
	25	9.2	Le
	25	8.7	G
	26	8.6	G
	27	9.2	Le
	27	9.0	V
	28	9.3	Le
	28	8.9	Hu
	31	9.2	Le
1	2	8.9	G
	8	9.0	Hu

030514
U Arietis

Mo.	Day	Est.	Obs.
12	12	13.0	Y

031401
X Ceti

Mo.	Day	Est.	Obs.
12	3	9.6	F

032043
Y Persei

Mo.	Day	Est.	Obs.
12	3	8.4	G
	6	9.4	C
	10	9.3	C
	12	8.4	B
	15	8.5	Hu
	16	8.2	G
	25	8.3	G
	26	8.2	G
	28	8.5	Hu
1	2	8.3	G

032335
R Persei

Mo.	Day	Est.	Obs.
12	12	9.0	Y
	16	8.9	Y

042215
W Tauri

Mo.	Day	Est.	Obs.
12	12	12.2	Y

043065
T Camelop.

Mo.	Day	Est.	Obs.
12	7	11.5	Y
	12	11.0	Y
	16	10.5	Y

043274
X Camelop.

Mo.	Day	Est.	Obs.
12	12	12.5	Y

045307
R Orionis

Mo.	Day	Est.	Obs.
12	16	11.0	Y

045514
R Leporis

Mo.	Day	Est.	Obs.
12	2	8.3	G
	4	8.1	G
	5	9.2	L
	6	9.0	C
	7	7.9	G
	7	9.1	L
	9	8.6	Y
	10	9.0	C
	12	7.9	B
	15	8.8	L
	19	7.6	G
	22	7.5	G
	25	7.3	B
	25	7.5	G
	26	7.5	G
	27	8.7	Ha
	28	8.3	V
	31	7.4	G
1	1	7.9	B
	3	8.0	F
	4	7.8	Ba

050022
T Leporis

Mo.	Day	Est.	Obs.
12	22	8.2	G

050003
V Orionis

Mo.	Day	Est.	Obs.
12	16	10.9	Y

050953
R Aurigae

Mo.	Day	Est.	Obs.
12	5	9.1	G
	9	9.4	J
	10	9.3	C
	12	9.3	J
	12	8.9	B
	12	9.0	O
	12	8.8	Y
	13	9.4	J
	19	8.9	G
	20	8.9	B
	20	9.8	J
	25	9.5	J
	26	9.1	G
	26	9.1	B
	28	9.8	J

052034
S Aurigae

Mo.	Day	Est.	Obs.
12	5	9.8	L
	9	9.9	L
	12	9.1	Y
	19	8.8	G
	23	8.9	G
	25	9.0	G
	26	9.0	G
1	1	9.1	G

052036
W Aurigae

Mo.	Day	Est.	Obs.
12	26	10.5	G

053068
S Camelop.

Mo.	Day	Est.	Obs.
12	7	8.7	Y
	12	8.8	Y

053531
U Aurigae

Mo.	Day	Est.	Obs.
12	26	11.0	G

054319
SU Tauri

Mo.	Day	Est.	Obs.
12	16	9.8	Y

054920
U Orionis

Mo.	Day	Est.	Obs.
12	6	10.0	C
	10	10.2	C
	15	11.2	Hu
	28	10.0	S
	28	12.0	Hu
1	8	12.1	Hu
	9	9.9	O

055353
Z Aurigae

Mo.	Day	Est.	Obs.
12	12	10.2	Y

VARIABLE STAR OBSERVATIONS Dec.–Jan. 1912-13.—Continued.

060124
S Leporis

Mo.	Day	Est.	Obs.
1	1	6.9	G

060450
X Aurigae

Mo.	Day	Est.	Obs.
12	5	10.1	G
	26	11.6	G

064932
Nova Gem. 2

Mo.	Day	Est.	Obs.
12	2	8.1	G
	3	7.6	L
	4	8.0	G
	5	7.7	L
	6	7.8	C
	6	8.1	G
	7	7.8	L
	9	8.0	G
	9	7.5	M
	9	7.8	L
	10	7.7	C
	11	7.8	L
	12	7.8	O
	13	7.8	V
	15	7.8	L
	17	7.7	G
	19	7.9	G
	22	8.0	G
	25	8.2	G
	26	7.8	O
	27	8.7	Y
	30	8.1	G
	31	8.2	G
1	1	8.2	G
	2	8.3	G
	4	8.1	O
	9	8.3	O

065355
R Lyncis

Mo.	Day	Est.	Obs.
12	7	9.8	Y
	9	9.9	J
	12	9.5	Y
	12	9.8	B
	13	9.7	J
	16	9.6	Y
	20	9.8	J
	28	9.6	J

070122 a
R Geminorum.

Mo.	Day	Est.	Obs.
12	6	9.6	C
	10	9.5	C
	28	9.4	Hu
1	8	9.6	Hu
	9	10.3	O

070310
R Can. Min.

Mo.	Day	Est.	Obs.
12	9	8.3	V
	28	8.3	V
	1	8.2	O
1	8	8.2	O

072708
S Can. Min.

Mo.	Day	Est.	Obs.
12	3	11.5	L
	5	11.3	L
	7	11.2	L
	9	11.2	L
	11	11.0	L
	15	10.6	Ha
	16	11.0	O
	27	10.5	Ha
	28	10.3	Ha
	30	9.9	G
	31	9.8	G
1	1	10.3	O
	1	9.9	B

073508
U Can. Min.

Mo.	Day	Est.	Obs.
12	3	9.7	L
	7	9.6	L
	7	9.7	Y
	11	9.9	L
	16	10.5	O
	16	10.5	Y

074922
U Geminorum

Mo.	Day	Est.	Obs.
12	28	11.6	Hu
	28	13.0	J
	31	13.6	J

081112
R Cancri

Mo.	Day	Est.	Obs.
12	3	10.5	L
	7	10.6	L
	10	10.5	C
	11	10.6	L
1	1	10.4	Ba

081617
V Cancri

Mo.	Day	Est.	Obs.
12	16	10.5	O
1	1	9.4	O
	2	9.3	G
	8	9.1	O

084803
S Hydrae

Mo.	Day	Est.	Obs.
1	1	10.0	O

085120
T Cancri

Mo.	Day	Est.	Obs.
12	3	8.8	L
	7	8.8	L
	11	8.6	L
1	1	9.0	O
	1	7.9	G
	8	8.8	O

093178
Y Draconis

Mo.	Day	Est.	Obs.
12	7	8.7	Y
	16	8.8	Y

093934
R Leo. Min.

Mo.	Day	Est.	Obs.
12	10	7.6	C

094211
R Leonis

Mo.	Day	Est.	Obs.
11	3	10.2	L
	7	10.1	L
	9	10.1	L
	10	10.2	C
	11	10.1	L
1	1	10.3	O
	1	10.0	G

103212
U Hydrae

Mo.	Day	Est.	Obs.
12	10	5.5	C

103769
R Urs. Maj.

Mo.	Day	Est.	Obs.
12	3	10.0	G
	3	10.8	L
	6	10.7	C
	7	10.9	L
	7	11.0	Y
	9	11.1	J
	10	11.0	C
	10	10.9	B
	11	10.9	L
	13	11 2	J
	13	11.0	Ha
	16	11.1	Y
	26	11.8	B
	28	11.6	J
	31	11.8	J
	31	11.4	G
1	1	11.9	B
	5	12.4	Ba

121418
R Corvi

Mo.	Day	Est.	Obs.
12	10	9.5	C

123160
T Urs. Maj.

Mo.	Day	Est.	Obs.
12	3	8.2	Bu
	3	8.2	L
	5	8.1	L
	7	8.2	L
	8	8.2	Bu
	8	8.1	J
	9	8.1	M
	10	8.2	C
	10	8.2	J
	11	8.2	L
	14	8.2	J
	15	7.8	Bu
	15	8.0	M
	16	8.3	Y
	20	8.3	J
	25	7.6	Bu
	28	8.3	Ba

T Urs. Maj.

Mo.	Day	Est.	Obs.
	28	8.2	S
	31	9.0	J
1	1	8.5	O
	2	7.9	M
	5	8.4	Ba

123307
R Virginis

Mo.	Day	Est.	Obs.
12	10	7.2	C

123961
S Urs. Maj.

Mo.	Day	Est.	Obs.
12	3	8.4	L
	3	8.4	Bu
	5	8.3	L
	7	8.3	Y
	7	8.2	L
	8	8.4	Bu
	8	8.6	J
	9	8.5	G
	9	8.6	M
	10	8.6	C
	10	8.7	J
	11	8.3	L
	14	8.6	J
	15	8.2	Bu
	15	8.5	M
	16	8.0	Y
	20	8.9	J
	25	7.8	Bu
	27	8.6	Ha
	28	8.4	Ba
	28	8.8	S
	29	8.6	J
	31	8.7	J
	31	8.4	G
1	1	8.5	O
	2	8.8	M
	5	8.3	Ba

132422
R Hydrae

Mo.	Day	Est.	Obs.
12	5	7.1	L
	7	7.1	L
	9	7.0	L
	10	6.8	C

132706
S Virginis

Mo.	Day	Est.	Obs.
12	3	7.3	L
	5	7.0	L
	7	7.1	L
	9	7.3	L
	10	7.0	C
	11	7.1	L

134440
R Can. Ven.

Mo.	Day	Est.	Obs.
1	2	11.8	M

141567
U Urs. Min.

Mo.	Day	Est.	Obs.
12	8	12.1	J
	31	11.1	J

141954
S Boötis

Mo.	Day	Est.	Obs.
12	3	10.0	L
	7	10.0	L

142539
V Boötis

Mo.	Day	Est.	Obs.
12	3	8.0	L
	5	8.0	L
	7	8.0	L
	9	7.9	L
	9	7.0	G
	11	8.0	L

142584
R Camelop.

Mo.	Day	Est.	Obs.
12	3	11.0	L
	7	11.0	L
	7	11.4	B
	9	11.4	J
	26	12.3	B
1	1	12.3	B

143227
R Boötis

Mo.	Day	Est.	Obs.
12	3	8.2	L
	5	8.3	L
	7	8.4	L
	9	8.6	L
	9	8.5	G
	11	8.6	L

153378
S Urs. Min.

Mo.	Day	Est.	Obs.
12	2	8.4	G
	3	8.5	L
	5	8.4	L
	7	8.6	L
	9	8.5	L
	15	8.7	L
	19	9.0	G
	25	8.9	G
	31	9.0	G

154428
R Cor. Bor.

Mo.	Day	Est.	Obs.
12	3	6.1	L
	6	6.0	Ma
	7	5.9	L
	9	5.9	L
	10	5.4	C
	11	5.9	L
	21	5.8	Ma
	31	5.6	Ma

VARIABLE STAR OBSERVATIONS Dec.–Jan. 1912-13.—Continued.

155847
X Herculis

Mo.	Day	Est.	Obs.
12	3	6.1	L
	7	6.3	L
	8	6.3	L
	9	6.2	L

163172
R Urs. Min.

Mo.	Day	Est.	Obs.
1	1	9.2	B

163266
R Draconis

Mo.	Day	Est.	Obs.
12	3	8.1	F
	3	7.8	Bu
	3	8.0	L
	5	7.9	G
	5	7.8	L
	6	8.1	C
	7	8.0	L
	7	8.1	Y
	8	7.8	Bu
	9	8.1	L
	9	7.9	J
	10	8.2	C
	12	8.1	J
	15	7.6	Bu
	16	8.3	Y
	20	8.3	J
	25	7.4	Bu
	25	8.8	J
1	1	9.3	J

180531
T Herculis

Mo.	Day	Est.	Obs.
12	3	8.1	L
	4	8.2	V
	5	8.3	L
	6	8.4	L
	6	8.3	C
	7	8.4	L
	8	8.6	L
	9	8.8	L
	10	8.4	C
	11	8.2	V

181136
W Lyrae

Mo.	Day	Est.	Obs.
12	2	7.6	G
	6	7.9	C
	7	8.4	Y
	9	7.6	G
	10	7.9	C
	19	7.9	G
	22	8.0	G
	25	8.0	G

184205
R Scuti

Mo.	Day	Est.	Obs.
12	3	6.5	L
	5	6.6	L
	6	6.5	C
	7	6.8	Ma
	7	6.5	L
	8	6.7	L
	9	6.7	L
	10	6.6	C
	11	6.7	L

191350
TZ Cygni

Mo.	Day	Est.	Obs.
12	3	10.7	L
	7	10.8	L
	8	10.8	L

193449
R Cygni

Mo.	Day	Est.	Obs.
12	3	11.4	L
	3	11.4	F
	5	11.4	L
	6	11.4	L
	6	11.5	G
	7	10.4	Ma
	9	11.5	G
	9	11.2	L
	10	10.7	B
	11	11.2	L
	13	10.7	Ha
	13	10.0	Ma
	14	9.8	Ma
	15	11.0	L
	15	10.8	F
	15	10.6	Ha
	16	11.0	G
	17	9.6	Ma
	19	10.0	F
	20	9.1	Ma
	23	9.8	Ha
	25	9.2	G
	25	9.1	B
	25	8.8	Ma
	27	9.3	Ha
	27	10.5	V
	28	9.2	Ha
	28	8.7	Ma
	30	9.2	G
	31	9.1	G
	31	9.1	Ha
1	1	8.4	Ma
	1	9.0	M
	2	8.9	G
	3	9.4	F

193732
TT Cygni

Mo.	Day	Est.	Obs.
12	3	8.6	Bu
	3	8.0	F
	6	8.2	C
	8	8.2	Bu

TT Cygni

Mo.	Day	Est.	Obs.
	10	8.1	C
	12	8.2	O
	15	8.4	Bu
	15	8.2	C
	15	7.8	F
	19	7.7	F
	19	7.3	G
	19	8.2	O
	22	7.5	G
	25	8.6	Bu
	26	7.4	G
	30	7.5	G
1	1	7.5	G
	3	8.1	F

194048
RT Cygni

Mo.	Day	Est.	Obs.
12	2	11.5	G
	3	11.3	F
	9	11.5	G
	10	11.0	B
1	3	10.0	F

194348
TU Cygni

Mo.	Day	Est.	Obs.
12	3	9.3	F
	3	10.1	L
	7	10.4	L
	9	11.0	M
	15	9.4	F
	19	9.6	F

194632
χ Cygni

Mo.	Day	Est.	Obs.
12	2	7.2	G
	3	8.0	Bu
	3	7.9	L
	3	7.5	F
	5	8.4	L
	5	7.4	G
	6	8.5	L
	6	8.7	C
	7	8.6	L
	8	8.0	Ha
	8	8.6	L
	8	8.4	Bu
	9	8.7	L
	9	8.6	J
	9	7.8	G
	10	8.7	L
	10	8.7	C
	12	8.8	O
	12	8.6	J
	13	8.4	Ha
	15	8.5	Ha
	15	8.8	O
	15	8.8	Bu

χ Cygni

Mo.	Day	Est.	Obs.
	19	8.8	F
	19	8.7	G
	19	9.0	O
	20	9.4	J
	25	9.4	J
	25	9.6	L
	25	9.2	Bu
	25	9.3	G
	26	8.9	B
	26	9.0	G
	27	9.1	Ha
	28	9.5	J
1	1	9.2	G
	3	9.7	F
	5	10.1	J

200647
SV Cygni

Mo.	Day	Est.	Obs.
12	3	8.8	F
	6	9.5	C
	9	8.8	G
	10	9.6	C
	10	8.8	B
	12	9.4	O
	15	9.4	O
	17	9.0	G
	19	8.9	F
	22	8.8	G
	25	8.4	B
	28	9.4	O
	28	9.1	G
	31	9.2	G
1	3	10.1	F

200715 a
S Aquilae

Mo.	Day	Est.	Obs.
12	3	11.1	F
	7	11.0	B
	26	10.9	B
1	3	9.6	F

200715 b
RW Aquilae

Mo.	Day	Est.	Obs.
12	3	9.0	F
	7	9.4	B
	26	9.3	B
1	2	9.2	B
	3	9.0	F

200916
R Sagittae

Mo.	Day	Est.	Obs.
12	3	9.1	F
	7	8.8	B
	26	9.8	B
1	3	9.1	F

200938
RS Cygni

Mo.	Day	Est.	Obs.
12	3	7.0	F
	6	7.8	C
	9	8.3	J
	9	7.1	G
	10	7.7	C
	12	7.5	O
	13	8.3	J
	13	7.7	Ha
	15	7.5	O
	17	6.9	G
	18	6.9	G
	20	8.2	J
	25	8.1	J
	28	7.2	Ha
	30	7.6	G
	31	7.3	G
1	5	8.1	J

201008
R Delphini

Mo.	Day	Est.	Obs.
12	7	11.5	B
	25	10.4	J

201130
SX Cygni

Mo.	Day	Est.	Obs.
12	16	12.9	Y

201647
U Cygni

Mo.	Day	Est.	Obs.
12	3	10.3	F
	4	10.5	G
	5	11.6	L
	8	11.6	L
	9	11.5	J
	9	11.5	L
	9	10.5	G
	13	11.6	J
	20	11.4	J
	22	10.2	G
	25	11.2	J
	25	10.2	G
	28	11.0	J
	28	10.2	G
	31	10.1	G
1	3	10.5	F
	5	10.9	J

202539
RW Cygni

Mo.	Day	Est.	Obs.
12	31	9.0	G
1	2	8.8	G

202846
TV Cygni

Mo.	Day	Est.	Obs.
12	3	9.8	L
	8	9.9	L
	9	9.6	L

VARIABLE STAR OBSERVATIONS Dec.–Jan. 1912-13.—Continued.

202946
SZ Cygni

Mo.	Day	Est.	Obs.
12	2	9.5	G
	3	9.4	L
	3	9.5	F
	4	9.7	G
	6	9.7	C
	6	9.9	G
	7	9.7	B
	7	9.8	G
	8	9.9	Le
	8	9.5	L
	9	9.5	G
	9	9.7	Le
	9	9.6	L
	10	9.6	B
	10	9.4	C
	11	9.3	L
	11	9.5	Le
	12	9.3	Le
	12	8.9	B
	13	9.3	Le
	14	9.2	Le
	15	9.1	L
	16	8.9	G
	17	8.7	G
	19	9.5	F
	19	9.4	G
	21	9.6	Le
	22	9.7	Le
	22	9.9	G
	23	9.7	Le
	23	10.0	G
	24	9.8	Le
	24	9.8	G
	25	9.5	Le
	25	9.5	B
	25	9.6	G
	26	9.5	G
	27	9.4	Le
	28	8.7	Ba
	28	9.1	Le
	28	9.1	G
	30	8.8	G
	31	9.1	Le
	31	9.2	B
	31	8.8	G
1	1	3.3	Ba
	2	9.1	G
	3	9.5	F
	4	9.5	O

203847
V Cygni

Mo.	Day	Est.	Obs.
12	4	8.8	G
	9	9.3	G
	17	9.0	G
	22	8.8	G
	25	8.7	G
	28	8.6	G
	31	8.8	G

203816
S Delphini

Mo.	Day	Est.	Obs.
12	7	9.5	Y
	16	8.7	Y

204016
T Delphini

Mo.	Day	Est.	Obs.
12	7	10.0	Y
	16	9.9	Y

204405
T Aquarii

Mo.	Day	Est.	Obs.
12	6	7.8	C
	9	7.7	J
	10	7.7	C
	11	7.5	V
	25	7.7	J

205923
R Vulpeculae

Mo.	Day	Est.	Obs.
12	3	8.1	L
	5	7.9	L
	6	7.7	L
	7	7.9	L
	8	7.8	L
	9	8.3	J
	9	7.7	L
	10	7.9	L
	10	8.5	C
	11	7.8	L
	12	8.3	J
	12	8.5	O
	13	8.2	J
	15	8.5	O
	20	8.7	J
	25	9.1	J
	28	9.0	O
	28	9.2	J
1	5	9.7	J

210116
RS Capricorni

Mo.	Day	Est.	Obs.
12	6	8.4	C
	10	8.1	C

210382
X Cephei

Mo.	Day	Est.	Obs.
12	7	9.4	Y
	16	9.4	Y

210868
T Cephei

Mo.	Day	Est.	Obs.
12	3	7.8	Bu
	3	8.1	L
	4	7.3	V
	5	7.9	L
	8	7.9	L
	8	8.2	Bu
	9	7.9	L
	9	8.1	J

T Cephei

Mo.	Day	Est.	Obs.
12	10	8.1	C
	11	7.5	V
	13	8.2	J
	15	8.3	L
	15	7.8	Ha
	15	8.4	Bu
	15	8.4	O
	19	8.5	O
	20	8.5	J
	22	7.8	V
	25	8.9	J
	25	8.6	Bu
	26	8.6	O
	28	9.1	J
	31	8.6	G
1	5	9.3	J
	9	9.2	O

213244
W Cygni

Mo.	Day	Est.	Obs.
12	2	5.2	G
	3	5.5	L
	4	5.6	L
	4	5.2	G
	5	5.6	L
	6	5.5	L
	6	6.0	C
	7	5.5	L
	7	5.4	G
	8	5.6	L
	9	5.5	L
	10	5.7	L
	10	6.5	C
	11	5.8	L
	12	6.6	O
	15	5.8	L
	16	5.8	G
	18	5.9	G
	22	6.0	G
	25	6.0	G
	25	6.4	L
	31	6.1	G

213678
S Cephei

Mo.	Day	Est.	Obs.
12	15	9.6	Hu
1	8	10.0	Hu

213753
RU Cygni

Mo.	Day	Est.	Obs.
12	3	8.2	F
	9	8.7	G
	19	8.6	G
	26	8.6	O
	31	8.6	G
1	1	8.5	G
	9	8.7	O

213843
SS Cygni

Mo.	Day	Est.	Obs.
12	3	9.6	F
	3	10.9	L
	4	8.7	L
	4	8.5	G
	5	8.5	L
	5	8.5	G
	6	8.6	L
	6	8.5	G
	6	8.6	C
	7	8.6	L
	7	8.4	G
	7	9.0	Hu
	7	9.0	B
	7	8.7	Y
	8	8.5	L
	9	8.3	L
	9	8.3	M
	9	8.4	G
	9	8.3	Le
	9	8.3	J
	10	8.4	L
	10	8.4	C
	10	8.6	B
	11	8.5	L
	11	8.3	Le
	12	8.3	Le
	12	8.8	B
	12	8.4	J
	12	8.7	Y
	12	8.4	O
	13	8.3	J
	13	8.6	V
	13	8.4	Le
	14	8.4	Le
	14	8.4	J
	15	9.1	L
	15	9.4	O
	16	9.5	J
	16	9.4	O
	16	9.6	G
	16	9.3	Y
	17	10.2	G
	18	11.0	G
	19	10.9	F
	20	11.9	J
	25	11.8	B
	25	12.1	J
	28	11.8	Ba
	28	12.0	J
1	5	12.1	J

213937
RV Cygni

Mo.	Day	Est.	Obs.
12	2	7.1	G
	3	7.0	F
	6	8.2	C
	6	7.1	G

RV Cygni

Mo.	Day	Est.	Obs.
12	8	8.2	Le
	9	7.9	Le
	9	8.4	J
	10	8.1	C
	11	8.1	Le
	12	8.0	Le
	12	7.2	B
	12	7.2	O
	13	7.9	Le
	13	8.4	J
	14	8.0	Le
	15	7.2	O
	16	7.1	G
	19	7.3	F
	20	8.4	J
	21	7.8	Le
	22	7.6	Le
	22	7.0	G
	23	7.6	Le
	24	7.6	Le
	25	8.4	J
	25	7.7	Le
	27	7.7	Le
	28	7.7	Le
	28	8.5	J
	31	7.2	Le
	31	7.0	G
1	3	7.6	F
	4	7.2	O
	5	8.3	J
	9	6.9	O

215934
RT Pegasi

Mo.	Day	Est.	Obs.
12	12	10.5	Y
	16	10.4	Y

222439
S Lacertae

Mo.	Day	Est.	Obs.
12	7	11.3	Y
	16	10.7	Y

230110
R Pegasi

Mo.	Day	Est.	Obs.
12	2	8.1	G
	7	7.4	Hu
	12	8.5	O
	12	8.5	Y
	16	8.7	Y
	23	8.6	G
	24	8.7	G
	26	8.7	G
	28	9.0	O
	31	8.9	G
1	9	9.5	O

VARIABLE STAR OBSERVATIONS Dec.–Jan. 1912-13.—Continued.

230759 V Cassiopeiae				231508 S Pegasi				ST Androm.				*233815* R Aquarii				235939 SV Androm.			
Mo.	Day	Est.	Obs.	Mo.	Day	Est.	Obs.	Mo.	Day	Est.	Obs.	Mo.	Day	Est.	Obs.	Mo.	Day	Est.	Obs.
12	14	12.0	J	12	23	9.0	G	12	26	9.6	O	12	6	10.0	C	12	12	9.8	Y
	25	12.1	J	1	2	9.3	G		28	9.2	S		10	10.0	C		16	8.4	Y
	28	12.2	J						28	9.4	Ba								
					233335				30	9.1	G		235350				245381		
	231425				ST Androm.			1	1	9.5	Ba		R Cassiop.				U Cephei		
	W Pegasi			12	7	9.2	G		4	9.4	Ba	12	6	10.6	C	12	25	9.0	G
12	6	10.3	V		23	9.0	G		9	9.6	O		10	10.8	C	1	2	7.0	G
	13	10.6	V									1	1	10.9	B				

No. of observations, 914; No. of stars observed, 117; No. of observers, 17.

Mr. H. C. Bancroft Jr., of West Collingswood, N. J., has a new 5½″ refractor, and Mr. F. C. Leonard, of Chicago, Ill., a new 4″ refractor. Both glasses are equatorials, and in the efficient hands of these observers will doubtless render the Association good service.

Attention is called to an error in the set of observations of 213843 SS Cygni in last month's report. Miss Young's observation November 30 reads 11.1 whereas it should read November 29, 11.6, which places her observation well in accord with those of other observers.

There is greater discord in the observations this month than there should be. The chief purpose of these reports is to correct mistakes in identification. Observers finding a wide variance in their estimates, in any save the very red variables, are requested to exercise special care in the identification of the variable when they next observe.

There are a number of cases where it is impossible for the secretary to decide definitely which observer is in error, as for instance where only two observers send in observations of the same variable. This emphasizes the desirability of individually increasing our observing list so that there may be many observations of each variable. When this is the case there is little difficulty in discovering who is probably in error when there is a wide variance in estimates. A long list also serves to divide the observer's work up so that there is less chance for remembering the previous estimate, which is fatal to accurate work.

Dr. Gray again receives the decoration for the greatest number of observations sent in this month,–177. Most of us would like to know how he does it! However, we all admire his diligence, and the splendid service he is rendering. Mr. Lacchini was a close second to Dr. Gray with 165 observations, an enviable record.

Messrs. Jacobs, Lacchini, Leonard, McAteer and Olcott estimated 213843 SS Cygni at 8.3 the night of December 9, quite a remarkable case of agreement in estimating stellar light values. Dr. Gray made it 8.4 in close agreement with the other observations.

WM. TYLER OLCOTT
Corresponding Sec'y.

Norwich, Ct., Jan. 10, 1913.

Ephemeris for Physical Observations of the Sun.

[From *The Companion to the Observatory* for 1913.]

1913	Greenwich Mean Noon. P.	D.	L.
	° ′	° ′	° ′
Jan. 1	+ 2 1	−3 10	6 12
6	− 0 26	3 44	300 21
11	2 51	4 16	234 31
16	5 13	4 46	168 40
21	7 32	5 14	102 50
26	9 45	5 40	37 0
31	11 52	6 2	331 10
Feb. 5	13 53	6 22	265 20
10	15 47	6 39	199 31
15	17 32	6 52	133 40
20	19 9	7 4	67 49
25	20 37	7 10	1 58
Mar. 2	21 56	7 14	296 7
7	23 5	7 15	230 14
12	24 4	7 12	164 21
17	24 53	7 6	98 26
22	25 32	6 56	32 31
27	26 1	6 44	326 35
Apr. 1	26 19	6 29	260 37
6	26 26	6 10	194 38
11	26 22	5 50	128 39
16	26 7	5 26	62 38
21	52 41	5 1	356 35
26	25 4	4 33	290 32
May 1	24 16	4 3	224 27
6	23 17	3 32	158 22
11	22 7	2 59	92 15
16	20 48	2 25	26 7
21	19 19	1 50	319 59
26	17 41	1 15	253 49
31	15 54	0 39	187 40
June 5	13 59	−0 3	121 29
10	11 58	+0 34	55 19
15	9 52	1 10	349 8
20	7 41	1 45	282 56
25	5 26	2 19	216 45
30	− 3 10	+2 53	150 34

1913	Greenwich Mean Noon. P.	D.	L.
	° ′	° ′	° ′
July 5	− 0 55	+3 26	84 24
10	+ 1 23	3 57	18 14
15	3 38	4 26	312 4
20	5 50	4 54	245 54
25	7 59	5 20	179 45
30	10 4	5 43	113 37
Aug. 4	12 4	6 4	47 29
9	13 57	6 23	341 23
14	15 44	6 39	275 17
19	17 25	6 52	209 11
24	18 58	7 2	143 7
29	20 24	7 10	77 4
Sept. 3	21 41	7 14	11 1
8	22 50	7 15	304 59
13	23 50	7 13	238 58
18	24 41	7 8	172 58
23	25 22	6 59	106 58
28	25 53	6 48	40 59
Oct. 3	26 14	6 34	335 0
8	26 25	6 16	269 2
13	26 25	5 56	203 5
18	26 13	5 33	137 7
23	25 49	5 8	71 11
28	25 14	4 40	5 14
Nov. 2	24 27	4 10	299 19
7	23 29	3 38	233 23
12	22 18	3 4	167 28
17	20 56	2 29	101 33
22	19 23	1 52	35 39
27	17 40	1 14	329 45
Dec. 2	15 46	+0 37	263 52
7	13 44	−0 2	197 58
12	11 35	0 40	132 5
17	9 19	1 19	66 13
22	6 58	1 56	0 21
27	4 34	2 32	294 29
32	+ 2 7	−3 8	228 38

The position angle of the Sun's axis, P, is the position-angle of the N. end of the axis from the N. point of the Sun, read in the direction N., E., S., W. In computing D (the heliographic latitude of the center of the Sun's disc), the inclination of the Sun's axis to the ecliptic has been assumed to be 82° 45′, and the longitude of the ascending node for 1913.0 to be 74° 32′.7. In computing L (the heliographic longitude of the center of the Sun's disc), the Sun's period of rotation has been assumed to be 25.38 days, and the meridian which passed through the ascending node at the epoch 1854 Jan. 1, Mean Noon, has been taken as the zero meridian.

COMMUNICATIONS AND QUESTIONS.

The Evening Sky.—Every clear evening now, rising slowly and splendidly from the eastward, the most spectacular sidereal exhibition of the darkened firmament is to be seen, sparkling and scintillating behind and above the roofs and spires of this huge metropolis. On some clear, cold, cloudless, moonless evening, from some standpoint removed from the dazzling glitter of electric lights, from high roof or amid suburban surroundings, one after another of the star gems and constellations of what may be called the "glorious galaxy" is to be seen climbing slowly and splendidly from the eastern horizon toward the firmamental zenith. Among these starry beacons of our December skies there shines brightly and placidly the three ringed planet Saturn, and the star-gazer will have little difficulty in finding this famous and unique planet, because of its inactive, mirrorlike appearance and because it is situated not far firmamentally from the ruddy sun Aldebaran and the haze-like group of the Pleiades in the constellation of Taurus, the Bull.

The brilliant, sparkling sun Capella is in the van of this "glorious galaxy," glittering like a sidereal crown at the apex of the constellation of Auriga, the Charioteer. Queen Capella is, far the brightest of the six principal suns constituting Auriga, part of which lies against the background of the well known Milky Way, and in the sky neighborhood of Queen Capella and Auriga there is to be seen the ruddy sun Aldebaran in the midst of the constellation Taurus, with the haze-like group of the minute Pleiades in the same constellation. Below ruddy Aldebaran and Taurus there sparkles splendidly the famous constellation of Orion, with its nine principal suns. The brightest of these nine suns are, respectively, Rigel, Betelgeuse and Bellatrix, although Betelgeuse is named Alpha and Rigel is Beta of this constellation, Betelgeuse being at the top, Rigel at the bottom, while between these two suns there glitter the three "belt stars" of Orion. These three "belt stars" form a sort of diagonal line or link which points, in the direction of the horizon, pretty accurately toward the glorious and incomparable sun Sirius, at the top of its constellation, Canis Major. As would be expected from its fiery brilliancy, King Sirius is the brightest of all the suns of night as visible from our little earth. Above King Sirius and the five other principal suns of Canis Major, eastwardly from Orion and its brilliants, there sparkles the first magnitude sun Procyon, with its inconspicuous constellation of Canis Minor. Lastly above Procyon and Canis Minor there shine the inseparable twin suns Castor and Pollux, situated at the end of the somewhat rectangular constellation of Gemini. At the other end of Gemini, close upon the mysterious myriads of the Milky Way, the star-gazer will find Gamma of Gemini, a sun that is popularly known by the name of Alhena.

This brings us back to Queen Capella and her constellation Auriga, and in our sidereal trip we have studied and described six brilliant suns and six constellations. Of these six brilliant suns, Sirius, Capella, Aldebaran and Rigel are among the brightest of the suns of night visible from this earth, while the constellation of Orion is world famous. At its best, under favorable conditions, the "glorious galaxy" is indeed a most spectacular sidereal exhibition, as it rises, sparkling and scintillating, from horizon toward the zenith, behind and above the roofs and spires of this huge metropolis.

CHARLES NEVERS HOLMES.

Boston, Mass. Dec. 1912.

The Sun's Change of Declination at the Solstices and Equinoxes. QUESTION.—How long does it take the sun to cross the last degree of declination before reaching the tropic of Cancer or the summer solstice; the last degree before and the first degree after the winter solstice? Also how long does it take the sun to change one degree in declination at the equinoxes?

ANSWER.—The sun will be at 23° 27′ 10.″5 north declination at the summer solstice June 21^d $8^h.0$, Washington mean time. It will be at 22° 27′ 10.″5 north declination June 4^d $5^h.5$, and again July 8^d $11^h.2$; therefore it will take the sun 17^d $2^h.5$ to cross the last degree of declination before reaching the tropic of Cancer: and 17^d $3^h.2$ to go south one degree after reaching the tropic of Cancer.

The sun will be at 23° 27′ 10″.1 south declination at the winter solstice Dec 21^d $17^h.4$. It will be at 22° 27′ 10″.1 south declination Dec. 5^d $15^h.9$, and again Jan. 6^d $18^h.1$; therefore it will take the sun 16^d $1^h.5$ to cross the last degree of declination before reaching the tropic of Capricorn, and 16^d $0^h.7$ to go north one degree after reaching the tropic of Capricorn.

The sun will be ½° south of the equator March 19^d $5^h.8$, and ½° north of it March 21^d $18^h.6$; therefore it will take 2^d $12^h.8$ to change one degree in declination at the vernal equinox.

The sun will be ½° north of the equator September 21^d $16^h.0$, and ½° south of is September 24^d $5^h.5$; therefore it will take 2^d $13^h.5$ to change one degree in declination at the autumnal equinox.

GENERAL NOTES.

It has been proposed to the municipal authorities of Paris that the memory of Henri Poincaré should be honored where he taught, and it is suggested that the portion of the Rue Vaugirard between the Boulevard St. Michel and the Odéon should be named after him. (*Science* Jan. 17, 1913.)

Dr. Lewis Swift, well-known among astronomers for his discoveries of comets and nebulæ, died at his home in Marathon, New York, on January 4, 1913, at the ripe old age of 92 years. We hope to be able to give a fitting review of his life in our next issue.

Dr. George E. Hale, lectured at the Massachusetts Institute of Technology on December 17 on "The Magnetic Field of the Sun."

Major E. H. Hills, F. R. S., has been appointed honorary director of the Observatory, University of Durham.

The International Union for Solar Research, which last met on Mount Wilson, Cal., in 1910, will hold its next meeting in Bonn, beginning August 1, 1913.

Mr. Frederick C. Leonard reports that he has recently substituted a 4-inch refractor for the 3-inch which he has been using up to this time at 1338 Madison Park, Chicago. The optical parts of this instrument are by O. L. Petitdidier, and the mechanical, (including the tube and the finder), are by Wm. Gaertner & Co., both of Chicago. The telescope is provided with Gaertner's portable mounting having clock and circles. There is an ample equipment of eyepieces by Mr. Petitdidier.

The Death of Eben J. Loomis on the second of December removed the last member of the original staff of the U. S. Nautical Almanac Office which the late Rear Admiral Davis gathered about him at Cambridge when the American Ephemeris was first inaugurated by the Government in 1850. Others were Chauncy Wright, Benjamin Peirce, Joseph Winlock, J. M. VanVleck, and later Simon Newcomb and G. W. Hill. His father, Nathan Loomis, also served in a similar capacity; and Eben, who was born on the 11th of November 1828, rounded out a term of service on the staff of the Ephemeris which embraced a full half century. He resigned in 1900, and has since resided with his son-in-law, Professor David Todd, at Amherst, Massachusetts. Early in life he was a student at the Lawrence Scientific School of Harvard with Louis Agassiz and Asa Gray, under whom he became a very keen observer of nature, and in 1877 he discovered a remarkable self motion of *Asplenium trichomanes* which brought him a most interesting letter from Charles Darwin. Among his published works are *Wayside Sketches* (1894), *An Eclipse Party in Africa* (1896), *A Sunset Idyl and Other Poems* (1903).

The Mount Rose Observatory.—This meteorological observatory was built in 1906 on a peak of the Sierra Nevada Mountains at the western edge of the Great Plateau as a private enterprise for the purpose of ascertaining the winter minimum temperatures at the summit of these mountains. The observatory has since been made a part of the University of Nevada. The equipment of this meteorological station is interesting in that the instruments are automatic in making the records, and it is not necessary to have an observer at the station continuously since many of the instruments have been constructed to work for long periods of time without attention. One of the lines of investigation has given rise to the temperature survey, the purpose of which is the determination of those regions in which fruit growing may be carried of profitably so far as the influence of frosts on this industry is concerned.

Another problem is the study of the effect of the topography of a region and its forests in the conservation of snow. This question relates the work of the observatory directly to the question of irrigation and water power in streams which are fed by snow.

The staff of the observatory consists of Professor J. E. Church, Jr. meteorologist, Professor S. P. Ferguson, associate meteorologist, and Mr. A. L. Smith, observer in Lake Tahoe Basin.

New Observatory for the Illinois Watch Company.—This company at Springfield, Ill., has under construction an observatory building, which will be completed in a few months.

The equipment includes an 8½-inch refractor with an objective and optical accessories by Petitdidier of Chicago. The mounting, embodying all the latest improvements, has been designed and made in the factory of the Illinois Watch Company.

A 3-inch combined transit instrument and zenith telescope of special design is being made by the Wm. Gaertner Co., of Chicago, who also furnish a chronograph. The finest sidereal and meantime clocks will be installed in especially designed room with automatic heat regulation. A wireless apparatus capable of registering Washington time signals is also in contemplation.

The primary object of the enterprise is accurate time service for use in the company's work of timing and adjusting watch movements, but it is hoped that by making the observatory freely accessible to the public under competent direction, it may serve a useful purpose in promoting popular interest and instruction in Astronomy.

A Sun-Power Plant in Egypt.—At Meadi, a suburb of Cairo, is a sun-power plant of unusual interest, It consists of five reflectors, each 204 feet long whose cross-section is in the form of a parabola, with the generator units at the focus. The last named are of zinc, built of rectangular sections fourteen inches wide. To render them efficient they are painted with a black paint of high heat-absorbing capacity. The water is introduced at the lower end and the generator at its upper end is provided with a steam connection four inches in diameter. The reflectors are lined with silvered glass mirrors. The plant works best at a pressure slightly below the atmosphere (*Scientific American* Jan. 18, 1913.)

Parallax Investigations on 41 Southern Stars.—Vol. II, Part III of the Transactions of the Astronomical Observatory of Yale University contains the results of heliometer measures of the parallax of 41 stars between the equator and the thirteenth parallel of south declination. Thirty six of these stars have proper motion of 0″.5 or greater, the remaining five being stars of the second magnitude. The regular plan was to secure sixteen complete sets of observations for each star from the best available pair of comparison stars, the sets being arranged symmetrically, four, eight and four respectively, at succeeding epochs of maximum parallactic displacement. Nine of the 41 stars yielded negative parallaxes, one zero and the others positive parallaxes ranging from 0.″008 to 0″.307. The calculated probable errors of the parallaxes range from ±0″.013 to ±0″.022.

Catalogue of Yale Parallax Results.—Vol. II, Part IV, of the Transactions of the Astronomical Observatory of Yale University contains a very valuable catalogue in which are collected together all of the parallax results obtained at that observatory. The catalogue includes 242 stars, two of these, β and 61 Cygni, being double stars for which the parallax has been determined for both components. For 100 of these stars the parallax has been measured by at least one other observer and a comparison of results is given in a supplementary table following the catalogue. The spectral type of each star is given together with its magnitude and that of the comparison star.

The following table gives the averages of the parallax results for 238 stars arranged according to proper motion and according to magnitudes of the stars.

	″ ″		″ ″		″ ″		″ ″		″ ″	
Proper Motion	0.00–0.34		0.41–0.54		0.55–0.65		0.66–0.96		0.97–7.04	
Magnitude	Par.	No.	Par.	No.	Par.	No.	Par.	No.	Par.	No.
	″		″		″		″		″	
0.0—2.5	+0.017	18	+0.100	2	+0.113	3	0		+0.200	2
3.0—5.0	+0.026	9	+0.024	7	+0.114	5	+0.095	10	+0.183	7
5.1—7.0	—0.010	7	+0.036	17	+0.059	19	+0.041	18	+0.085	15
7.1—9.0		0	+0.035	31	+0.033	26	+0.024	27	+0.119	15

This shows a quite decided dependence of the parallax upon the proper motion of the star and much less marked dependence upon magnitude or brightness. Grouped according to proper motion alone the results are:

Proper motion ″ ″	Parallax ″	No. of Stars
0.00—0.34	+0.014	34
0.41—0.54	+0.036	57
0.55—0.65	+0.054	53
0.66—0.96	+0.042	55
0.97—7.04	+0.121	39

Grouped according to brightness alone the progression of the parallax is very slight but this is partly because for the fainter stars only those stars were selected for the observing list which had abnormally large proper motions and therefore abnormal parallaxes.

Magnitude	Parallax ″	No. of stars
0.0—2.5	0.058	25
3.0—5.0	0.084	38
5.1—7.0	0.048	76
7.1—9.0	0.044	99

The Smithsonian Expedition to Study the Heat of the Sun. Director Abbot, of the Smithsonian Astrophysical Observatory, has just returned from a five months' astronomical expedition to Bassour, Algeria. The object of the expedition was to confirm or disprove the supposed variability of the sun. The Astrophysical Observatory has been for seven years making observations on Mt. Wilson, in California, on the daily quantity of heat received from the sun. The observations are arranged in such a manner as to indicate not only the quantity of solar heat reaching the earth, but also the quantity of heat which would reach a body like the moon, which has no atmosphere.

The observations have indicated that the sun is probably a variable star having a range of variation amounting to from five to ten per cent within an irregular interval of from five to ten days. Last year Mr. Abbot observed in Algeria, while his colleague, Mr. Aldrich, observed on Mt. Wilson in California. The object of thus duplicating the measurements was to avoid being misled by any local atmospheric conditions which might have affected Mt. Wilson observations. As nearly one third of the circumference of the earth lies between Mt. Wilson and Algeria, it could not be expected that a similar local disturbance could affect both stations at the same day in the same manner. The observations of 1911 strongly supported the belief that the sun is variable, but owing to cloudiness their number was not sufficient fully to establish this point. Hence it was thought best to return to Algeria this year.

Mr. Abbot was assisted in Algeria by Mr. Anders Knutson Angström, of Upsala. Sweden. Mr. Angström comes from a distinguished family of scientists. His grandfather, Anders Angström, is the one of whom Kayser says in his great work on spectroscopy, "Now arose a man so great that his name will be forever associated with the history of spectroscopy." Mr. Angström's father, Knut Angström, was scarcely less distinguished than the grandfather, and invented many valuable instruments for measuring the radiation of the sun and earth. The present Mr. Angström is much interested in the same problems that occupied his father, and is now pursuing advanced work at Cornell University.

The observations made by the Smithsonian party in Algeria this year were apparently very satisfactory. They occupied sixty-four days and on more than fifty of these days Mr. Fowle made similar observations on Mt. Wilson, in California. It can hardly be doubted that the results of the work of 1911 and 1912 will thoroughly establish the supposed variability of the sun, or will show conclusively that this hypothesis can no longer be held. (*Science*, Oct. 25, 1912.)

Resumé of Sun Spot Observations, 1912.

Month	No. of Obs.	Days Without	North of equator No. groups	Av. Lat.	South of equator No. groups	Av. Lat.	Av. No. at each Obs.	New Groups
Jan.	17	17	0	.....	0	.....	0.00	0
Feb.	23	23	0	.....	0	.....	0.00	0
Mar.	14	9	1	+15°.2	0	.....	0.36	1
Apr.	14	10	1	15 .0	0	.....	0.28	1
May	19	14	2	14 .2	0	.....	0.26	2
June	11	10	1	15 ·0	0	.....	0.09	0
.....								
Sept.	9	1	0	.....	2	−10°.6	0.89	2
Oct.	21	17	0	.....	2	10 .7	0.19	2
Nov.	18	17	0	.....	1	8 .0	0.06	1
Dec.	12	7	1	18 .0	1	4. 8	0.50	2
Total	158	125	6		6			11

Average number at each observation 0.22
Average latitude of spots north of equator ..... + 15°.5
Average latitude of spots south of equator ..... − 8°.5

Most of the observations were made by Miss Louise F. Jenkins, Assistant in the Observatory.

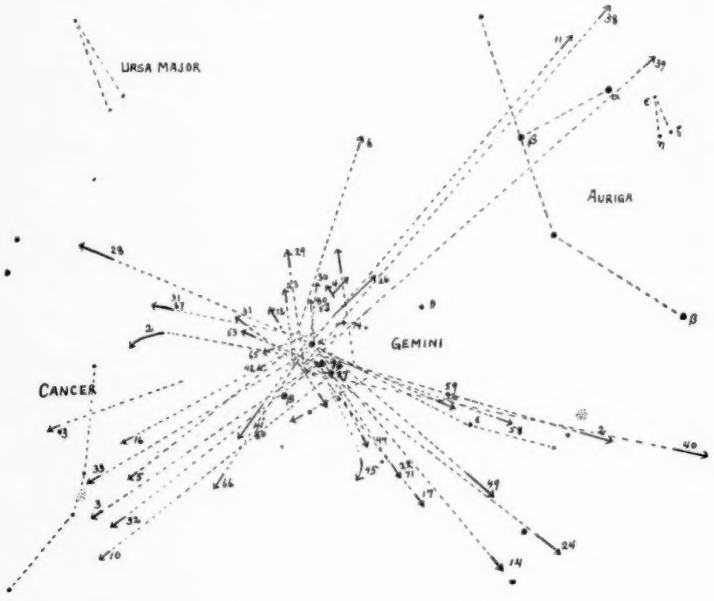
ANNE SEWELL YOUNG.

Mount Holyoke College.

Geminids, Dec. 12, 1912.—December 12 was as clear as crystal until 11:45 when it clouded up and remained cloudy the rest of the night. Between 10:15 p. m. and 12:45 a. m. 89 Geminids and three others were seen. Between 12:45 and 12:50 four Geminids were observed between the clouds. While it was clear the rate was 35 an hour, but the rate was irregular, as much as 15 minutes passing without one appearing, then several together or in quick succession would come. Four and three at one time were seen in the space of a second. The Geminids were fainter and slower than in past years, although No. 35 equalled the crescent moon in brilliancy and No. 41 left a long green trail which lasted three seconds and seemed to be visible longer. The radiant point was near α Geminorum, ¼ of the way between α and β and a little N. W. This radiant point either covered an appreciable area or was composed of several radiants, as several came from a point half way between α and δ. Next to the Perseids the Geminids seem to appear each year the most consistently and the hourly rate this year was greater than that of the Perseids. In every year they have always appeared in fairly good numbers on December 12. They were short, blue, red or white, and several left trails. One feature was the distinctly blue color. Eight were red, six blue and the rest white. Eleven left distinct trails, three of which were green.

By half hour periods,

1912, Dec. 12		Geminids	Others	Notes
10:15	10:45	11	1	
10:45	11:15	17	2	Leonids
11:15	11:45	21		
11:45	12:15	18		10 minutes not watching.
12:15	12:45	21		clouding up 12:40
12:45	12:50	4		cloudy 12:50
		92		



GEMINIDS, DECEMBER 12, 1912.

Greatest number in 1 second 4, and 39 were seen between 11:45 P.M. and 12:45 A.M.

By magnitude,

−5	−1	0	1	2	3	4	5	6	
1	6	7	9	22	14	13	0	20	92

November 15 was watched for Leonids and only 1 was seen, close to the radiant, in an hour's watch.

R. M. DOLE.

Charleston, South Carolina.

The Cleveland Meeting of the Astronomical and Astrophysical Society of America was held at the Case School of Applied Sciences, from December 31 to January 2, in connection with the meeting of the American Association for the Advancement of Science and allied societies. The buildings of Adelbert College, of the Western Reserve University and the Case School of Applied Sciences, which stand side by side, were nearly all thrown open to the use of the various sections and societies. A number of excursions were arranged by the citi-

zens of Cleveland for the benefit of the visitors. The visits to the Peerless Automobile Works and to Warner & Swazey's Steel Works were much appreciated by a number of astronomers and physicists. At Warner and Swazey's a number of telescope mountings, equatorial and meridian, were exhibited, as well as the marvelously accurate dividing engine which they use for graduating the circles of their meridian instruments.

The following members of the astronomical society were present at the meeting:

Sebastian Albrecht, S. I. Bailey, L. A. Bauer, J. A. Brashear, E. W. Brown, C. A. Chant, W. A. Cogshall, W. S. Eichelberger, Philip Fox, William Gaertner, James Hartness, W. J. Humphreys, F. C. Jordan, Kurt Laves, T. A. Lawes, W. I. Milham, E. W. Morley, J. A. Parkhurst, E. C. Pickering, J. S. Plaskett, W. F. Rigge, H. N. Russell, Frank Schlesinger, H. T. Stetson, R. M. Stewart, J. N. Stockwell, G. S. Swesey, W. R. Warner, F. P. Whitman, D. T. Wilson, H. C. Wilson, Anne S. Young, E. I. Yowell.

The following members attended the joint session of the astronomical society with Sections A and B of the A. A. A. S: G. F. Hull, N. A. Kent, E. F. Nichols and D. C. Miller.

Visitors present were: G. L. Coyle, S. J., S. F. Cusick, S. J., Patrick Rafferty, S. J. and J. I. Shannon, S. J.

Sessions of the society were held on the forenoons of Tuesday, Wednesday and Thursday and the afternoon of Wednesday. On Tuesday afternoon a joint session was held with Sections A (Mathematics and Astronomy) and B (Physics) of the A. A. A. S. and the American Mathematical Society, at which the following papers were read:

E. B. Frost: The Spectroscopic Determination of Stellar Velocities, considered practically, (Read by Professor J. A. Parkhurst).

R. A. Millikan: Unitary Theories in Physics.

A. G. Webster: Henri Poincaré as a Mathematical Physicist.

E. J. Wilczynski: Some General Aspects of Modern Geometry.

L. A. Bauer: Cosmical Magnetic Fields.

At the four sessions of the society thirty-five papers were presented, numbers 6, 12 and 31 being read by title. Numbers 8 and 30 were read before the joint session. President E. C. Pickering presided over the sessions a good portion of the time, although he was also President of the A.A.A.S. and necessarily absent part of the time. In his absence Vice-President Frank Schlesinger occupied the chair.

PROGRAM.

1. F. W. Very: The Correction of Actinometer Measurements for Aqueous Depletion. (Read by Professor Cogshall).
2. W. F. Rigge: Astronomy in the Civil Court.
3. E. C. Pickering: A Northern Durchmusterung.
4. S. I. Bailey: Rate of Light Changes in Various Celestial Objects.
5. Wm. Gaertner: A New Type of Printing Chronograph. (Presented by Professor Fox).
6. Wm. Gaertner: Correcting and Testing Micrometer Screws. (Read by Title).
7. Frederick Slocum: Circulation in the Solar Atmosphere as Indicated by Prominences. Second Paper. (Read by Professor Parkhurst.)
8. L. A. Bauer: Cosmical Magnetic Fields.
9. D. T. Wilson: The Jupiter Perturbations of the Group of Small Planets, $\mu = {}^{2}/_{5}$.
10. H. C. Wilson: Visualizing the Sun's Way.

11. Walter S. Adams: Stellar Spectroscopic Notes. (Read by Professor Fox).
12. F. W. Very: The Temperature Assigned by Langley to the Moon. (Read by Title).
13. Annie J. Cannon: The Spectra of the Gaseous Nebulæ. (Read by Professor Pickering).
14. W. J. Humphreys: On Climate Changes and the Origin of Ice Ages.
15. J. A. Parkhurst: The Scale of the Yerkes Actinometry
16. J. A. Parkhurst: The Color-scale of the Yerkes Actinometry.
17. O. J. Lee: Orbit of the Spectroscopic Binary π^5 Orionis. (Read by Professor Schlesinger).
18. Kurt Laves: Recent Progress in the Theory of the Galilean Satellites of Jupiter.
19. J. S. Plaskett: The Solar Rotation in 1912.
20. J. S. Plaskett: Relative Intensity of Prismatic and Diffraction Spectra.
21. R. M. Stewart: A New Form of Clock Synchronization.
22. R. M. Stewart: The Expression of Pivot Errors by a Formula.
23. S. D. Townley: The Light-Curve of RV Capricorni. (Presented by Professor Fox).
24. H. T. Stetson: An Investigation of the 9.4 inch Photographic Objective of the Shattuck Observatory.
25. H. N. Russell: The Luminous Efficiency and Color-Index of a Black Body at Different Temperatures.
26. H. N. Russell: Notes on the Mean Parallax and Absolute Magnitude of Variable Stars.
27. Harlow Shapley: The Eclipsing Binary ϵ Aurigae. (Read by Professor Russell).
28. J. A. Miller: The Sproul Observatory. (Read by Title).
29. F. E. Ross: Film Distortion on Small Photograhic Plates. (Read by Professor Eichelberger).
30. G. E. Hale: Preliminary Note on an Attempt to Detect the General Magnetic Field of the Sun. (Read by Dr. Bauer).
31. John M. Poor: Orbital Planes of Binaries. (Read by Title).
32. F. H. Seares: Photographic and Visual Variation of RR Draconis. (Read by Professor Fox).
33. F. H. Seares: Photographic Magnitudes of the Brighter Stars of the Polar Sequence. (Read by Mr. Jordan).
34. Sebastian Albrecht: On R Lyrae with a Three-Prism Slit-Spectrograph.
35. R. H. Curtiss: Some Changes in the Spectrum of Nova Geminorum. (Read by Professor Plaskett).
36. F. E. Ross: Some Effects of Radiation on Astronomical Instruments. (Read by Professor Eichelberger).
37. W. S. Eichelberger: Do the Declinations of the Star Catalogues Represent the Actual Declinations?

A Remarkable Meteoric Fall, July 19, 1912.—In the *American Journal of Science* for November 1912, Mr. W. M. Foote gives a preliminary note on a remarkable fall of meteoric stones on July 19, 1912, at Aztec, near Holbrook, Navajo county, Arizona. His summary of the main facts of the fall and finding of the stones are as follows:

"Between 6:20 and 6:40 P.M. on July, 19 1912, a large meteor was heard traveling in an easterly direction and passing over Winslow, Holbrook and Aztec, points along the Sante Fe Railroad, which here parallels the Rio Puerco River. It made a very loud noise, lasting half a minute to one minute. (One observer states that the loud reports were followed by lesser rumblings for four or five minutes.) This noise has been variously likened by witnesses, to the rumbling of a rapidly driven farm wagon on a rough road, to escaping steam, to distant and long continued thunder or the booming of a cannon. It was heard at Concho, St. Joseph and Woodruff and at Pinedale, some forty miles away. One large explosion was quicky followed by several small ones in rapid succession. Charles Von Aachen and his son then saw numerous stones fall at Aztec, raising many puffs of dust for a mile or more over the dry sand of the desert, like those produced by bullets or the first drops of rain in a heavy shower. They did not see the stones in the air. Some fell near a building; and one is said to have severed the branch of a tree. The meteor was not seen during its flight, as it was too early in the evening for its luminosity to be visible. Its speed could not be estimated, but it was 'terrific' according to one account. Its path was indicated to many by a train of thin smoky vapor, which spread out after the meteor passed. One observer estimated that the explosion occurred one or two miles above the earth. The weather at the time was slightly cloudy.

"The stones were scattered over an ellipsoidal area roughly estimated by the two finders to be about one-half mile wide and three miles long. As frequently recorded in meteoric falls, the longest diameter of this ellipsoid was in line with the trajectory of the meteor, being east and west. Most of the smaller fragments lay on the top of the loose sandy soil; the larger pieces were about half buried, some to a depth of six inches, apparently having fallen slantingly from the west. The large and small stones, according to all answers received, were said to be indiscriminately spread over the ground, without regard to size. In previous stone showers the small stones have been found first in the line of flight, then the medium, and finally the largest. The violent disruptions near Holbrook might account for the lack of such separation of the sizes, provided an explosion occurred near the end of the flight. Just such a late disruption was evidenced by the nearly fresh fracture of many fragments. Visitors from nearby towns soon gathered the larger stones. Von Aachen, who saw them fall, reported that they were too hot to pick up. Two accounts state that they became lighter in color after cooling." Most of the stones have been acquired by the Foote Mineral Company of Philadelphia, who estimate the number of fragments in their possession at 15,019 classified as follows:

29	fragments	weighing over 1000	grams each
6000	"	" 1 to 1000	" "
8000	"	" less than 1	gram "

Chemical analysis of the fragments shows that the body was an aërolite containing less than 4 per cent of nickel-iron and 96 per cent of silica.

Such stone showers as this are rare and this is one of the most remarkable recorded. The following is a list of the principal showers of the nineteenth century:

Date of Fall	Locality	Recorded No. of Stones	Recorded Weight of Fall in Grams.
Apr. 26, 1803	L'Aigle, France	2000-3000	36,843
Dec. 14, 1807	Weston, Connecticut	Many	18,267
May 22, 1808	Stannern, Austria	200-300	38,408
May 1, 1860	New Concord, Ohio	Over 30	97,811
June 9, 1866	Kuyahinya, Hungary	Over 1000	423,120
Jan. 30, 1868	Pultusk, Poland	About 100,000	200,932
Jan. 1, 1869	Hessle, Sweden	Many	22,895
Feb. 12, 1875	Homestead, Iowa	Many	124,492
Feb. 3, 1882	Möcs, Hungary	Over 100,000	155,632
May 2, 1890	Forest, Iowa	Many	122,037
July 19, 1912	Holbrook, Arizona	Over 14,000	218,310

The question of the connection of this meteor with the *Aquarid* or *Perseid* showers of meteors, which are known to be active about July 19, has been examined by Professor Eric Doolittle, of the Flower Observatory of the University of Pennsylvania, whose conclusion is that it is "not impossible that this most interesting fall might have come from the *Perseid* swarm, and therefore be an actual part of or an attendant to Tuttle's comet of 1862", but from the data in hand this connection cannot be established.

Prizes Awarded by the French Academy of Sciences.—In the *Comptes Rendus* Dec. 16, 1912 is given the list of prizes awarded for last year by the French Academy of Sciences. Those in astronomy are:

The Lalande Prize; awarded to Messrs. H. Kobold and C.W. Wirtz, of Strassburg, for their determination of accurate position of 1554 nebulae, the construction of a normal catalogue in which they are compared with former observations and a discussion of errors of position, both accidental and systematic,

The Valz Prize; awarded to Mr. Alexander Schaumasse, of Nice, for his comet discoveries.

The Janssen Medal; awarded to Mr. Perot, of Meudon, for the introduction of the differential method into the study of spectra and the notable increase in precision in all his measures of wave-length.

Durchmusterung Charts of the Southern Heavens.—The National Observatory of the Argentine Republic is republishing the Cordoba Durchmusterung maps of the sky between declinations $-22°$ and $-42°$, suppressing the stars fainter than magnitude 9.5. The first three maps, covering the first six hours of right ascension, have already been issued, and the other nine are to follow as rapidly as they can be made.

List of Intermedial Stars.—In the Bulletin *du Comité International Permanent pour l'execution photographique de la Carte du Ciel*, Tome VII Part 1, Professor F. Küstner, director of the Observatory at Bonn, gives a selected list of 6163 stars "intermédiaires". These are so chosen that they are quite uniformly distributed over the northern celestial hemisphere, six or seven falling within the limits of every area $2°$ square, i. e., within the area upon each of the photographic plates of the chart of the sky. They were selected so that all are to be found in the *Astronomische Gesellschaft* Catalogues (Epoch 1875.0) and in the Bonn Catalogue for 1900. There is thus on hand at once material for determining their approximate proper motions. They will doubtless be placed at once upon the Meridian Circle "Observing Lists" of many observatories and in a few years have their places determined with great accuracy. By means of them the places of millions of faint stars on the photographic plates may be reduced to a consistent uniform system and so in years to come the motions of these faint stars may be studied as those of the brighter ones are being studied now.

Solar Radiation.—It is often stated that astronomy has little or no practical value to-day. However much this may seem to apply to some phases of this most interesting line of investigation, it certainly cannot be urged against efforts made to determine the amount and character of the sun's heat. Every living thing receives the greater part of its energy from the sun. Atmospheric circulation and climate are dependent upon the same source of heat. If, therefore, it will be possible to find the exact amount of heat we receive from the sun; if we can determine whether or not it varies from day to day and, if so, according to what law; if we can connect solar radiation with climate and weather, it would be of untold value to all mankind.

The Smithsonian Institution of Washington has for many years made special studies on solar radiation and easily ranks first in this regard. Evidence has been brought forward by Prof. C. G. Abbot, director of the astrophysical work of the Institution, that the amount of heat radiated by the sun is not constant. With present appliances, however, it has not been possible to determine whether the whole surface is effective in this or not. In order to attack this problem the Smithsonian Institution is erecting, at its station on Mount Wilson in Callfornia, a "tower" telescope, forty feet high. This instrument will be very similar to the 60-foot tower telescope of the Mount Wilson Solar Observatory. The new telescope will also be used in studying the intensity of light from the sky and the reflecting power of clouds.

When completed this instrument will be a powerfull means of grappling with some of the great problems of solar physics, and in the hands of Prof. Abbot and his assistants we feel sure of its efficient use to this end. (*Scientific American*, Dec. 28, 1912.)

New Observatory at Los Angeles.—From clippings sent us from the Los Angeles newspapers we learn that that city is to have a splendid new educational observatory, to be erected on Mt. Hollywood, the highest point in Griffith Park. Colonel Griffith J. Griffith who gave to the city Griffith Park, has formlly offered to the city $100,000 for this purpose. The observatory is to be fully equipped on or before the year 1915.

"In brief the plan is this: Mr. Griffith will erect a building of concrete, on the summit of Mt. Hollywood, which has an elevation of 1700 feet. The main building will be two stories in height. Various halls, rest rooms, recreation rooms and a moving picture theater will be provided. A portion of the building will be three stories, the third story to be used as the observatory. It will be equipped with a number of nautical telescopes for use by the public in surveying the surrounding park country, the city, the beach towns, ships at sea, the island—whatever there may be of interest within the line of vision,— and also with telescopes for the popular study of the stars and planets. The observatory portion of the building will be so constructed that, if later it is deemed advisable, an additional structure may be erected above it for scientific astronomical studies. The observatory will be equipped under the direction of Professor Edgar L. Larkin, director of the Lowe Observatory."

Colonel Griffith is quoted as saying: "If the cost of the project goes beyond $100,000 which I have pledged, I will pay the bills just the same. I want this institution on the summit of the peak to be educative. I want the masses to be attracted there and to be given something that will entertain them and at the same time make them think,—something that will lift them above their troubles and turn them to higher things.

The Upper Atmosphere.—The first prize of 2000 marks offered for competition by the German Meteorological Society for the best discussion of the results of the international investigation of the upper atmosphere has been awarded to Mr. E. Gold, the Superintendent of Statistics at the Meteorological Office. The successful essay was entitled "The International Kite and Balloon Ascents" (*The Observatory*, January 1913).

Exercises in Astronomy for Schools and Colleges, by Sarah Frances Whiting, Sc. D., Whitin Observatory, Wellesley College. Published by Ginn and Company, Boston.

This little book of 104 pages will serve a very useful purpose as a laboratory manual in connection with the study of Descriptive Astronomy. It contains 45 exercises (one a week for the year course) with full directions for their performance and very complete list of apparatus, maps, photographs and other material to be used in connection with the exercises. Miss Whiting is an experienced teacher and knows what the student can do, so that the exercises which she has arranged are practical for the average student, and where no large telescope is accessible.

Tables of the Weights of Air, of the Air-Pressure Equivalents and of Gravity by Dr. S. Riefler have been received at the Goodsell Observatory. The author of these tables was also the manufacturer of astronomical clocks and, in his study of the effect of slight barometric and thermometric changes in the atmosphere surrounding a swinging pendulum upon the arc and duration of oscillation of the pendulum, he was led to the preparation of these tables. The tables of the weights of air give the weight of a liter of air both dry and containing 50 per cent of moisture for pressures varying from 380 mm to 790 mm. for temperatures varying from $-1°$ to $+36°$ Celsius. These weights are given in milligrams to the nearest hundredth. The tables show that at the pressure of 760 mm, as the temperature changes from $-1°$ to $+36°$, the weight of a liter of air changes from 1296.61 mg. to 1129.78 mg. They also show that at the temperature 0°, as the pressure changes from 380 mm to 790 mm, the weight of a liter of air changes from 646.60 mg. to 1342.79 mg. The Air-Pressure Equivalent or the Pressure Equivalent of Temperature, a term introduced by the author, is defined as the reduction of pressure necessary to cause the same change in the weight of a unit volume of air as would be caused by a rise of one degree of temperature. These quantities are tabulated within the same limits of temperature and pressure as the weights of air. In the table of Gravity are given more than three hundred places on the earth, with their geographical positions and the value of gravity at these places determined by direct measurement. By simple reduction formulas it is possible to determine the constant of gravity for any place not given by referring it to one of the places that are given, by making the necessary corrections for differences in latitude and altitude.

An interesting statement is made concerning the precision of the Riefler clock No. 20 at Potsdam, in which an attempt has been made to compensate for all the influences, no matter how minute, that affect the swinging pendulum. The result is that the pendulum is made to swing with such exactness that after 576,000,000 seconds the error of the clock is only one second.

All the descriptive matter of the book is printed in parallel columns in German French and English. This is a great convenience and brings it within the reach of many more than a single language would do. An error in the English column on page 32 is noted in line 12 in which the word 'millimetres' should be substituted for 'degrees.' The book is published by Julius Springer, Berlin, Germany, and is sold for six marks.

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